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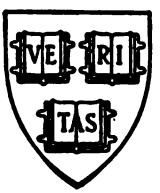

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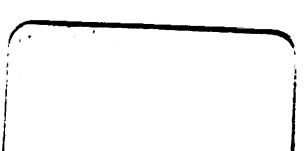

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REPORT OF THE

NATIONAL ACADEMY OF SCIENCES

FOR THE YEAR

1915

WASHINGTON
GOVERNMENT PRINTING OFFICE
1916

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REPORT OF THE

NATIONAL ACADEMY OF SCIENCES

FOR THE YEAR

1915

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CONTENTS.

	Page.
Letter of transmittal	5
Act of incorporation	7
Amendments	8
Proceedings	11
Meetings of the National Academy, 1915	12
Annual meeting—	
Members in attendance	12
Business sessions	12
Assignment of biographical memoirs	12
Announcement of deaths	13
Reports of the president and treasurer	13
Report of the home secretary	13
Report of the directors of the Bache fund	13
Report of the trustees of the Watson fund	14
Report of the committee on the Henry Draper fund	16
Report of the committee on the J. Lawrence Smith fund	16
Report of the directors of the Benjamin Apthorp Gould fund	17
Report of the trustees of the Wolcott Gibbs fund	17
Report of the committee on the Murray fund	18
Report of the committee on award of Barnard medal	18
Report of the committee on solar research	19
Business from the council	19
Dues for 1916	19
Date for elections	19
International Association of Academies	19
Fiscal advisers of the academy	19
Autumn meeting	19
Bequest of Mrs. Mary Anna Palmer Draper	19
Report of editorial board of the Proceedings	20
Report of committee on historical objects	21
Report of the committee of chairmen of sections	21
Election of members of the council	22
Election of new members	22
Constitution	22
Rules	22
Committee personnel	22
Scientific sessions	23
April 19	23
April 20	23
April 21	24
Presentation of Henry Draper medal	24
Autumn meeting	24
Members in attendance	24

Digitized by Google

Meetings of the National Academy, 1915—Continued.
Autumn meeting—Continued.
Business sessions— Page.
Announcement of deaths since annual meeting ... 25
Publications issued ... 25
Committee changes ... 25
Board of directors of the Bache fund ... 25
Board of directors of the Wolcott Gibbs fund ... 25
Chairmen of sections ... 25
Auditing committee ... 26
Editorial board changes ... 26
Delegates ... 26
Committee on Panama Canal ... 26
Marsh fund ... 26
Consolidation of funds ... 26
Report of the committee on the Henry Draper fund ... 27
Name of the academy ... 27
Report of the Committee on the Medal for Eminence in the Application of Science to the Public Welfare ... 27
Award of the Medal for Eminence in the Application of Science to the Public Welfare ... 28
Report of the editorial board of the Proceedings ... 28
New rule ... 28
Scientific sessions—
November 15 ... 29
November 16 ... 29
November 17 ... 30
Deceased members:
Frederick W. Putnam ... 30
Paul Ehrlich ... 33
Annual report of the treasurer:
General review of financial transactions ... 36
Condensed statement of receipts and expenditures ... 37
Statement of assets and liabilities ... 39
Accounts with individual funds ... 42
Report of auditing committee ... 46
Appendices:
Appendix A.—Constitution of the National Academy ... 49
Appendix B.—Rules ... 56
Appendix C.—Organization of the academy, 1915–16 ... 62
Sections ... 62
Standing committees ... 64
Trust funds ... 64
Members of the National Academy of Sciences, December 31, 1915 ... 67
Honorary member ... 69
Foreign associates ... 70
Deceased members ... 71
Deceased foreign associates ... 74

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LETTER OF TRANSMITTAL.

NATIONAL ACADEMY OF SCIENCES,
January 27, 1916.

The Honorable THOMAS R. MARSHALL,
Vice President of the United States,
Washington, D. C.

SIR: I have the honor to transmit to you herewith the annual report of the president of the National Academy of Sciences for the year ending December 31, 1915.

Very respectfully,

ARTHUR L. DAY,
Home Secretary.

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ACT OF INCORPORATION.

AN ACT To incorporate the National Academy of Sciences.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That Louis Agassiz, Massachusetts; J. H. Alexander, Maryland; S. Alexander, New Jersey; A. D. Bache, at large; F. B. Barnard,[1] at large; J. G. Barnard, United States Army, Massachusetts; W. H. C. Bartlett, United States Military Academy, Missouri; U. A. Boyden, Massachusetts; Alexis Caswell, Rhode Island; William Chauvenet, Missouri; J. H. C. Coffin, United States Naval Academy, Maine; J. A. Dahlgren, United States Navy, Pennsylvania; J. D. Dana, Connecticut; Charles H. Davis, United States Navy, Massachusetts; George Engelmann, Saint Louis, Missouri; J. F. Frazer, Pennsylvania; Wolcott Gibbs, New York; J. M. Gilless,[2] United States Navy, District of Columbia; A. A. Gould, Massachusetts; B. A. Gould, Massachusetts; Asa Gray, Massachusetts; A. Guyot, New Jersey; James Hall, New York; Joseph Henry, at large; J. E. Hilgard, at large, Illinois; Edward Hitchcock, Massachusetts; J. S. Hubbard, United States Naval Observatory, Connecticut; A. A. Humphreys, United States Army, Pennsylvania; J. L. Le Conte, United States Army, Pennsylvania; J. Leidy, Pennsylvania; J. P. Lesley, Pennsylvania; M. F. Longstreth, Pennsylvania; D. H. Mahan, United States Military Academy, Virginia; J. S. Newberry, Ohio; H. A. Newton, Connecticut; Benjamin Peirce, Massachusetts; John Rodgers, United States Navy, Indiana; Fairman Rogers, Pennsylvania; R. E. Rogers, Pennsylvania; W. B. Rogers, Massachusetts; L. M. Rutherford, New York; Joseph Saxton, at large; Benjamin Silliman, Connecticut; Benjamin Silliman, junior, Connecticut; Theodore Strong, New Jersey; John Torrey, New York; J. G. Totten, United States Army, Connecticut; Joseph Winlock, United States Nautical Almanac, Kentucky; Jeffries Wyman, Massachusetts; J. D. Whitney, California; their associates and successors duly chosen, are hereby incorporated, constituted, and declared to be a body corporate, by the name of the National Academy of Sciences.

SEC. 2. *And be it further enacted,* That the National Academy of Sciences shall consist of not more than fifty ordinary members, and the said corporation hereby constituted shall have power to make its

[1] The official list of members gives the name of F. A. P. Barnard.
[2] The official list of members gives the name of J. M. Gilliss.

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own organization, including its constitution, by-laws, and rules and regulations; to fill all vacancies created by death, resignation, or otherwise; to provide for the election of foreign and domestic members, the division into classes, and all other matters needful or usual in such institution, and to report the same to Congress.

SEC. 3. *And be it further enacted,* That the National Academy of Sciences shall hold an annual meeting at such place in the United States as may be designated, and the academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art, the actual expense of such investigations, examinations, experiments, and reports to be paid from appropriations which may be made for the purpose, but the academy shall receive no compensation whatever for any services to the Government of the United States.

Approved, March 3, 1863.

AMENDMENTS.

AN ACT To amend the act to incorporate the National Academy of Sciences.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the act to incorporate the National Academy of Sciences, approved March third, eighteen hundred and sixty-three, be, and the same is hereby, so amended as to remove the limitation of the number of ordinary members of said academy as provided in said act.

Approved, July 14, 1870.

AN ACT To authorize the National Academy of Sciences to receive and hold trust funds for the promotion of science, and for other purposes

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the National Academy of Sciences, incorporated by the act of Congress approved March third, eighteen hundred and sixty-three, and its several supplements, be, and the same is hereby, authorized and empowered to receive bequests and donations and hold the same in trust, to be applied by the said academy in aid of scientific investigations and according to the will of the donors.

Approved, June 20, 1884.

AN ACT To amend the act authorizing the National Academy of Sciences to receive and hold trust funds for the promotion of science, and for other purposes.

Be it enacted by the Senate and House of Repersentatives of the United States of America in Congress assembled, That the act to authorize the National Academy of Sciences to receive and hold trust funds for the promotion of science, and for other purposes, approved June twentieth, eighteen hundred and eighty-four, be, and the same is hereby, amended to read as follows:

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"That the National Academy of Sciences, incorporated by the act of Congress approved March third, eighteen hundred and sixty-three, be, and the same is hereby, authorized and empowered to receive, by devise, bequest, donation, or otherwise, either real or personal property, and to hold the same absolutely or in trust, and to invest, reinvest, and manage the same in accordance with the provisions of its constitution, and to apply said property and the income arising therefrom to the objects of its creation and according to the instructions of the donors: *Provided, however,* That the Congress may at any time limit the amount of real estate which may be acquired and the length of time the same may be held by said National Academy of Sciences."

SEC. 2. That the right to alter, amend, or repeal this act is hereby expressly reserved.

Approved, May 27, 1914.

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ANNUAL REPORT

OF THE

NATIONAL ACADEMY OF SCIENCES.

The year 1915 is conspicuous in the record of the activities of the academy because of the establishment at the beginning of the year of a monthly scientific journal called the Proceedings of the National Academy of Sciences. The undertaking was entered upon without the aid either of an endowment or of a government subvention, but through voluntary subscription by members and friends under the pressure of an acute need for a publication broad enough in scope to include all the interests of the academy, and one which should offer an opportunity for the prompt and accurate announcement of the scientific discoveries of members and others.

It is not the purpose of the proceedings to include long or detailed papers which appear more appropriately in the special journals conducted by scientific societies, but rather to supplement this detailed record, which is prepared usually for restricted circulation within the branch of science in which it originates, with an early general announcement of the essential features and results of important investigations both in the interest of scientific progress and of general knowledge.

It is particularly important, for example, that the results of American research should be brought to the attention of foreign investigators both in Europe and in South America, partly for the purpose of avoiding duplication of effort and partly in order to secure appropriate recognition of the great increase in the productiveness of American research during recent years. The National Academy, through its official affiliation with the representative scientific organizations of other nations and its close relations with a great number of unofficial foreign societies, is obviously in a peculiarly favorable position to disseminate the results of American scientific work, if indeed it is not definitely the duty of the academy to do so. No appropriate organ for the distribution of concise, authentic reports covering the whole broad field of American scientific studies has existed in the United States hitherto, and American research in consequence is much less well known abroad to-day than it is entitled to be.

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There is already evidence that the present effort will be successful in correcting this situation. The mailing list of the Proceedings already includes more than 900 foreign institutions of learning and research, distributed in all parts of the world, in addition to its American correspondents. To this great body of scientific workers the academy has presented, through its Proceedings, this first year which has just closed, 166 papers. To the academy this is a duty long unfulfilled rather than a privilege, perhaps, but its value to American scientific research is already clearly demonstrated and is likely to increase rapidly in this and following years.

MEETINGS OF THE NATIONAL ACADEMY.

During the year 1915 the academy held two stated meetings, the annual meeting in April at Washington and the autumn meeting in November, at New York City.

ANNUAL MEETING.

The sessions were held in the United States National Museum and in the Oak Room of the Raleigh Hotel, Washington, D. C., April 19, 20, 21, 1915. Fifty-eight members were present, as follows: Becker, Boltwood, Britton, Bumstead, Cattell, Chittenden, Clark (W. B.), Clarke (F. W.), Clarke (J. M.), Conklin, Coulter, Crafts, Cross, Dall, Davenport, Davis, Donaldson, Fewkes, Frost, Goodale, Hague, Hale, Harper, Harrison, Hayford, Hillebrand, Holmes, Howell, Jennings, Loeb, Mall, Meltzer, Mendel, Merriam, Michelson, Moore, Morgan, Morley, Nichols (E. L.), Noyes (A. A.), Noyes (W. A.), Osborn (H. F.), Osborne (T. B.), Parker, Pickering, Pirsson, Ransome, Reid, Remsen, Schuchert, Scott, Smith (E. F.), Walcott, Webster, Welch, Wheeler, White, Woodward.

BUSINESS SESSIONS.

The president announced that the preparation of biographical memoirs of deceased members had been assigned as follows:

Bowditch, Henry P., to Walter B. Cannon,
Davidson, George, existing biography approved.
Gould, Benjamin Apthorp, to George C. Comstock.
Mitchell, Henry, to John F. Hayford.
Mitchell, Silas Wier, to William H. Welch.
Chandler, Seth Carlo, to William L. Elkin.
Peirce, Benjamin Osgood, to E. H. Hall.
Holden, Edward Singleton, to W. W. Campbell.
Hill, George William, to E. W. Brown.
Peirce, Charles Sanders, to J. McK. Cattell.
Gill, Theodore Nicholas, to William H. Dall.
Minot, Charles Sedgwick, to F. P. Mall.
Billings, John Shaw, to Fielding H. Garrison.

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The president announced the death, since the autumn meeting, of one foreign associate:

Auwers, G. F. J. Arthur, elected 1883, died January 24, 1915.

REPORTS OF THE PRESIDENT AND THE TREASURER.

The reports of the president [1] and of the treasurer [2] for 1914, as transmitted to the Senate of the United States by the president of the academy, were presented in their printed form and approved.

REPORT OF THE HOME SECRETARY.

The President of the National Academy of Sciences.

SIR: I have the honor to present the annual report of the home secretary of the National Academy of Sciences for the year ending April 21, 1915.

The memoir of the National Academy of Sciences, volume 12, part 1, and bearing the title, "Monograph of the Bombycine Moths of North America," by A. S. Packard, edited by T. D. A. Cockerell, has been published and distributed to the members, foreign associates, institutions, and reference libraries; volume 12, part 3, of the memoirs, entitled, "The Turquois," by Joseph E. Pogue, has also been published and distributed; part 2 of this same volume entitled, "Variations and Ecological Distribution of the Snails of the Genus Io," by Charles C. Adams, has received final consideration, and is now waiting to be bound at the Government Printing Office; the memoir forming volume 13, being "A Catalogue of the Meteorites of North America," by Oliver C. Farrington, only awaits press work and binding before it is issued.

The biographical memoirs of John Wesley Powell, Charles A. Schott, and Miers Fisher Longstreth have been published. The publication of the memoir of Peter Lesley, by William M. Davis, has been approved by the committee on publication, and the biography of Henry Morton, by Edward L. Nichols, has been printed and awaits the portrait.

Three members have died since the last annual meeting: Theodore Nicholas Gill, on September 25, 1914, elected in 1873; Charles Sedgwick Minot, on November 19, 1914, elected in 1897; and Henry Lord Wheeler, on October 30, 1914, elected in 1909.

Of our foreign associates, Eduard Suess died on April 26, 1914, elected in 1898; August Weismann died on December 5, 1914, elected in 1913; Hugo Kronecker died on June 6, 1914, elected in 1901; G. F. J. Arthur Auwers died on January 24, 1915, elected in 1883.

There are 134 active members on the membership list, one honorary member, and 43 foreign associates.

ARTHUR L. DAY,
Home Secretary.

REPORT OF THE DIRECTORS OF THE BACHE FUND.

The serious illness of Dr. Charles S. Minot, the chairman of the board of directors of the Bache fund, made it difficult to carry on the work of the board for several months. His death in November last left a vacancy hard to fill as he was most conscientious in the performance of his duties. After careful consideration the two remaining members of the board elected Prof. Ross G. Harrison the third member and he accepted. In turn the board elected the undersigned chairman.

Since the last annual meeting of the academy the following appropriations have been made:

[1] Report of the National Academy of Sciences for the year 1914, pp. 11–56. [2] Idem, pp. 57–65.

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No. 182. W. C. Kendall. $600. April 30, 1914. Toward the expenses of illustrations in color and incidental expenses in connection with Part II (*Salmonidæ*) Fishes of New England to be published by the Boston Society of Natural History.

No. 183. C. G. Abbot. $250. June 29, 1914. To complete and test on Mount Wilson in California an apparatus consisting of a concave cylindric mirror of about 100 square feet surface adapted to heat oil to circulate through a reservoir containing ovens and water pipes, and thereby to utilize solar radiation for cooking and for heating water for domestic purposes.

No. 184. P. W. Bridgman. $500. September 14, 1914. To continue the work on high pressures, especially to investigate the phase changes brought about in various substances by very high pressure.

No. 185. Robert W. Hegner. $160. December 26, 1914. To determine the visible changes that take place during the differentiation of the germ cells in the embryos of hermaphroditic animals, and to discover, if possible, the cause of these changes.

No. 186. J. Voûte. $800. February 9, 1915. For the determination of parallaxes of southern stars by transits. The Bache fund has heretofore granted $1,000 for this research. It is conducted at the Royal Observatory, Cape of Good Hope, wholly at the expense of Mr. Vûote, except for these grants.

No. 187. H. H. Lane. $500. April 14, 1915. To make a comparative study of the embryos and young of various mammals in order to determine, by physiological experimentation and morphological observations, the correlation between structure and function in the development of the special senses.

IRA REMSEN,
Chairman.

APRIL, 1915.

REPORT OF THE TRUSTEES OF THE WATSON FUND.

The will of the late James Craig Watson provided "for the promotion of astronomical science," but he expressed the wish that a medal should be given and that tables should be prepared of the motions of all the planets discovered by him. This last wish has now been carried out in a most satisfactory manner by Prof. A. O. Leuschner, so that the income which has been used for this purpose during the last 14 years is now available for the promotion of astronomical science in other directions.

The undersigned accordingly recommend the following votes:

Resolved, That the Watson medal and the sum of $100 be awarded to Prof. Armin Otto Leuschner, for the skill and ability which he has shown in supervising the preparation of tables of the Watson asteroids, involving original methods, and leading to results of much value to celestial mechanics.

Resolved, That the sum of $500 from the income of the Watson fund be appropriated to Prof. John A. Miller, director of the Sproul Observatory, for measuring plates already taken for the determination of stellar parallaxes.

Resolved, That the sum of $300 be appropriated from the income of the Watson fund to Mr. John E. Mellish, to enable him to undertake observations at the Yerkes Observatory.

E. C. PICKERING, *Chairman.*
W. L. ELKIN.
EDWIN B. FROST.

APRIL 2, 1915.

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MARCH 25, 1915.

Prof. E. C. PICKERING,

Chairman Watson Trustees of the National Academy of Sciences,
Harvard College Observatory, Cambridge.

DEAR SIR: I beg to submit the following statement of the condition of the Watson work on March 1, 1915. This is a continuation of the reports submitted March 21, 1912; April 5, 1913; and April 1, 1914.

1. A year ago I reported that—

(*a*) In addition to the 12 planets published, 3 planets, (79) Eurynome, (150) Nuwa, and (121) Hermione were ready to be put into manuscript form.

(*b*) That (132) Aethra would be assigned to some other graduate student unless Mr. Champreux gave assurance that he would make progress. You will remember that this planet is not part of our list, as it is considered lost.

(*c*) That (175) Andromeda was completed on the basis of our revision of von Zeipel's tables.

(*d*) That the perturbations (106) Dione of the Hecuba group were developed and that it remained to make comparison between theory and observation.

(*e*) That (100) Hecate and (104) Clymene required a comparison between theory and observation, and a correction of the elements.

(*f*) That of the remaining two planets, in the case of (94) Aurora, a complete revision of the perturbations which had originally been done by Hansen's theory would be required on the basis of von Zeipel's theory, and that no work had as yet been undertaken on (168) Sibylla, which also belongs to the Hecuba group.

In making report at this time I shall refer to each of the items that was mentioned as incomplete in my last report under (*a*) to (*f*).

2. (*a*) and (*c*). These four planets were reported as entirely completed last year.

(*b*) (132) Aethra. Mr. Champreux has done nothing further, and Mr. W. D. Alter has recently undertaken the investigation of this case. As Luther's final elements, accepted by the Jahrbuch, made the mean motion of this planet very nearly three times that of Jupiter, its loss has been a matter of great theoretical interest. Owing to the great ease and accuracy of determining orbits by my own method, it seemed desirable to deduce a new orbit from the original observations, of which there were two sets, extending in all over 22 days. One set of these observations was made by Watson with a ring micrometer at Ann Arbor, and the other set was made with a Filar micrometer at Marseilles, France. Watson computed two orbits, resulting in daily motions of 980″ and 846″, respectively. Watson's orbits were based entirely on his own ring micrometer observations. Luther applied systematic corrections to these. He investigated the star places and produced a definitive orbit on the basis of both the Ann Arbor and Marseilles observations, obtaining a mean motion of 904″, and this orbit has been accepted by the Jahrbuch and is the one on the basis of which extensive but fruitless searches have been made for this planet. Mr. Alter's new orbit is based entirely on the Marseilles observations, while Watson's orbits were based entirely on the ring micrometer observations. Mr. Alter has obtained a reliable orbit which agrees exactly with the rejected orbit of Watson, getting a mean motion of 844″ as compared with that of Watson of 846″. This puts an entirely new aspect on the whole problem and proves that the search for this planet has been unavailable on account of the error in the accepted elements, about 1′ of arc per day in the mean motion, which for a number of years would of course make it impossible to locate it. Mr. Alter will continue this problem, compute the perturbations without charge to the Watson trustees, and I have no doubt will be able to decide what has become of the planet.

(*d*) The work on (106) Dione is now entirely completed.

(*e*) Nothing further has been done on (100) Hecate but in the case of (104) Clymene a complete revision by von Zeipel's theory is nearly completed.

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(*f*) Nothing further has been done on (94) Aurora, but (168) Sibylla has been completed entirely on the basis of von Zeipel's theory.

3. The investigation of the perturbations of the Watson asteroids is therefore completed with the exception of a final revision of (100) Hecate and (94) Aurora, both of which, as stated above, have been treated by Hansen's method with unsatisfactory results. We do not anticipate much difficulty in finally disposing of these two cases, on account of the very favorable conditions existing in them as compared to (175) Andromache, which readily yielded to our investigation.

4. Under these circumstances it appears certain that the work may be completed with the balance of the appropriation for the current year. Just how far we shall get with the clerical work of preparing the manuscript on the available balance I can not say at this time, but the cost of this clerical work will be slight. At any rate it need not be considered until after the whole volume has been printed. I can advance the same, if necessary, in the meantime.

5. The total appropriation made last year was $1,031.45, which included a balance of $71.45 of the preceding year and an allowance of $80 per month for the current year. Miss Sophia H. Levy continues as chief computer, with the assistance of Mr. O. D. Shane, the monthly expense being $80. Up to March 1 I have expended $580, leaving available for the completion of the work the sum of $451.45. As stated above this, I think, will be sufficient, possibly exclusive of the clerical work of preparing the manuscript and seeing the same through the press.

Respectfully submitted,

A. O. LEUSCHNER.

REPORT OF THE COMMITTEE ON THE HENRY DRAPER FUND.

The committee unanimously recommends to the academy that the following grants for research be approved:

Five hundred dollars to Dr. W. W. Campbell, director of the Lick Observatory, for the purchase and construction of spectrographic and other apparatus for use with the Crossley reflector.

Two hundred and fifty dollars to Dr. S. A. Mitchell, director of the Leander McCormick Observatory, for the purchase of a machine for measuring astronomical photographs.

GEORGE E. HALE,
Chairman.

REPORT OF THE COMMITTEE ON THE J. LAWRENCE SMITH FUND.

In regard to researches now in progress or lately completed which have received aid from this fund the committee reports as follows:

Grant No. 3. Edmund Otis Hovey, curator in geology and paleontology in the American Museum of Natural History, New York, received in 1910, a grant of $400 in aid of the study of certain meteorites. Metallographic and chemical examinations are in progress. Dr. Hovey is at this time out of the country.

Grant No. 4. Prof. C. C. Trowbridge of the department of physics in Columbia University received in 1910 a grant of $400 in aid of his study of the luminous trains of meteors. The academy has also made further grants of $250 in 1912, of $250 in 1913, and of $250 in 1914. The important work of collecting, verifying, and tabulating records of observations of luminous trains has been diligently pursued. Lately, the collection and preparation for publication of drawings of luminous trains has been undertaken. In accordance with the vote of the academy in 1912, three payments have been made from this grant and it is expected that the fourth and last installment will be required during the current year.

Grant No. 5. Dr. George P. Merrill, curator in the department of geology in the United States National Museum, received a grant of $200 in 1910, and of $200 in 1911.

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to aid in the study of the occurrence of certain elements suspected to be present in small quantities in some meteorites. This work has been successfully completed, and the final report is ready for submission to the academy; the report contains a tabulation of all available trustworthy analyses of meteorites, and is accompanied by a special paper on the occurrence in meteorites of francolite or some allied phosphatic mineral in place of the apatite of terrestrial rocks.

The committee recommends that the meteorites remaining from the purchases by Dr. Merrill be deposited by the National Academy of Sciences in the United States National Museum.

Prof. S. A. Mitchell, University of Virginia, has applied for a grant of $500 to aid in the computation of orbits of meteors. Dr. Charles P. Olivier, president of the American Meteor Society, has computed orbits from some 9,000 observations of meteor paths, and has some thousand observations awaiting reduction. He has published two important papers containing several hundred computed orbits. The committee recommends the grant of $500 to Prof. S. A. Mitchell, to aid in computations of orbits of meteors.

The cash balance of income now available for grants is $874.87, and the invested income is $1,532.50.

EDWARD W. MORLEY,
Chairman.

REPORT OF THE BOARD OF DIRECTORS OF THE BENJAMIN APTHORP GOULD FUND.

The income balance of the Gould fund is now, in cash, $404.64; in readily negotiable securities, $4,057.50; and in an unpaid grant to the Astronomical Journal, $1,000.

F. R. MOULTON,
Chairman.
E. E. BARNARD.

REPORT OF THE DIRECTORS OF THE WOLCOTT GIBBS FUND.

The directors of the Wolcott Gibbs fund for chemical research have the honor to present their annual report to the National Academy of Sciences.

Since the last report three grants have been made from the income of the fund as follows:

III. One hundred dollars to Prof. W. J. Hale, Ann Arbor, to pay for assistance in a research on derivatives of 2.3-diacetylpentadiene, voted May 15, 1914.

Prof. Hale reports that he has prepared the cyclopentadiopyridazine and the corresponding phenyl compound, and determined their composition. He hopes to finish the research before the summer vacation.

IV. Two hundred dollars to Prof. W. D. Haskins, University of Chicago, for making a special potentiometer and galvanometer to study cobaltammines and ternary systems of fused salts. Voted November 25, 1914.

Prof. Haskins reports that a beginning has been made on the work in spite of his severe sickness and the fact that the war has prevented him from obtaining part of the apparatus from Germany.

V. A second grant of $100 to Prof. Mary E. Holmes of Mount Holyoke College for assistance in her work on the electrolytic determination of cadmium. Voted March 18, 1915.

Prof. Holmes reports that she has purchased platinum electrodes of a new form, and with these has studied the deposition of cadmium and copper, so that she is now beginning to study the electrical separation of cadmium from other metals.

The unexpended income of the fund amounted on April 1 to $111.99.

C. L. JACKSON,
Chairman.

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REPORT OF THE COMMITTEE ON THE MURRAY FUND.

The committee on the Sir John Murray fund has to report that during the year 1913 there were exceptional and extraordinary expenses due to the designing and striking off of the Agassiz medal, rendered necessary by the terms of the gift. The committee deemed best not to touch the original fund, and the income derived from this fund at that time was not sufficient to meet these expenses. The committee therefore, with the consent of the treasurer, borrowed from the general fund of the academy a sum sufficient to meet these needs. On December 31, 1914, a portion of this indebtedness was repaid from the income derived from the Murray fund, leaving about $300 still due. By the end of the present calendar year the entire indebtedness of the Murray fund to the general fund will have been paid, leaving the Murray fund out of debt and prepared to meet the legitimate requirements of the fund.

This Murray fund ($6,000) is now drawing interest, and your committee in charge of this fund will be prepared in another year to recommend the bestowal of a second Agassiz medal, as intended by the donor of the gift, Sir John Murray, or possibly to suggest to the academy a contribution to further the science of oceanography.

ARNOLD HAGUE,
Chairman.

REPORT OF THE COMMITTEE ON AWARD OF BARNARD MEDAL FOR MERITORIOUS SERVICE IN SCIENCE.

Your committee on award of the Barnard medal begs leave to submit the following report:

The committee has considered many candidates, of which several have been esteemed generally worthy of recommendation for the medal in question. The terms of the specifications concerning the award of this medal impose, however, certain restrictions which must be borne in mind. These specifications are contained in the following paragraph from the will of the founder of the fund provided for the quinquennial bestowal of this medal:

"A gold medal of the value of $200, established by the provisions of the will of President Barnard and endowed by him, known as the 'Barnard medal for meritorious service to science,' is awarded quinquennially to such person, if any, whether a citizen of the United States or any other country, as shall within the five years next preceding have made such discovery in physical or astronomical science, or such novel application of science to purposes beneficial to the human race, as in the judgment of the National Academy of Sciences of the United States shall be esteemed most worthy of such honor."

Observing the limitations here set forth and giving careful attention to the individual merits of the candidates considered, your committee has reached the unanimous conclusion that William Henry Bragg, professor of physics in the University of Leeds, and his son, W. L. Bragg, now a student at the University of Cambridge, should be recommended for the next award. The reasons which have led your committee to this conclusion are briefly indicated in the following statement:

The doctrine of atomism, foreshadowed poetically by Leucippus, Democritus, and Lucretius, and raised to the dignity of an exceedingly fruitful hypothesis by Dalton and the modern schools of chemists and physicists, is now approaching the long-sought stage of verification and demonstration. Since the time of Dalton a multitude of investigators have contributed continuously toward the attainment of this advanced stage, but progress has been remarkably cumulative and rapid during the past quarter of a century. The fundamental importance of the several fields of research in which the atomic structure of matter is now being established is sufficiently indicated by the fact that four preceding awards of the Barnard medal have been made for researches in these fields. But this importance is now emphasized

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anew by the recommendation that the next award of the Barnard medal be made to Messrs. W. H. and W. L. Bragg, father and son, for highly meritorious work in the same fields.

About three years ago Dr. Laue and his collaborators of the University of Munich produced some remarkable photographs by passing a narrow beam of X-rays through a crystal of zinc blende. These photographs revealed geometrical figures strikingly suggestive of the molecular structure attributed by crystallographers to such minerals. The bearings of this discovery were quickly appreciated by a number of investigators, and extraordinary advances in crystallography, in the theory of X-radiation, and in the application of X-rays to the study of matter, have rapidly followed. In securing these advances the Messrs. Bragg have been preeminent. By means of a rare combination of experimental skill and theoretical insight they have been able to show that X-rays are essentially light rays of excessively short wave length and that crystalline structure is definitely molecular. They have determined the order of wave length of X-rays and they have also determined the order of the intervals which separate the molecules in certain crystalline forms. In a noteworthy series of luminous publications and in an equally noteworthy series of masterly public expositions they have supplied the initial methods and furnished many of the preliminary results which must lead to a still more productive era in the advancement of molecular physics and hence in the advancement of the entirety of physical science.

In view of these achievements your committee hereby unanimously recommends that Messrs. W. H. and W. L. Bragg be proposed to Columbia University for an award of the Barnard medal for the year 1915.

For the committee.

R. S. WOODWARD.

REPORT OF THE COMMITTEE ON SOLAR RESEARCH.

The committee begs to call the attention of the academy to the publication of Volume IV of the Transactions of the International Union for Cooperation in Solar Research, which contains the complete proceedings of the last meeting in Bonn, reports of the various committees, resolutions adopted by the Union, and several scientific papers on solar and stellar phenomena.

The four volumes of transactions already published by the Solar Union may be obtained from Messrs. Longmans, Green & Co., Fourth Avenue and Thirtieth Street, New York, at $2.50 per volume.

GEORGE E. HALE, *Chairman.*

BUSINESS FROM THE COUNCIL.

Recommended:

(*a*) That the annual dues for 1915 be $5.

(*b*) That the election of new members and of two members of the council be held Wednesday morning, April 21, 1915.

(*c*) That the treasurer be authorized to pay the annual subscription of 200 francs to the International Association of Academies.

(*d*) That the American Security & Trust Co., of Washington, D. C., and Spencer Trask & Co., of New York City, be designated fiscal advisers of the academy for 1915–16.

(*e*) That the time and place of the autumn meeting, 1915, be left to the president and the home secretary with power.

(*f*) That the following bequest from Mrs. Mary Anna Palmer Draper be accepted:

[Extract from the will of Mrs. Mary Anna Palmer Draper, page 7, section 9 (second paragraph).]

I give and bequeath to the National Academy of Sciences, Smithsonian Institution, Washington, D. C., the sum of twenty-five thousand dollars ($25,000).

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RESOLUTION.

The National Academy of Sciences, desiring to express its deep appreciation of the recent bequest of Mrs. Henry Draper, places this minute upon its records.

The name of Draper occupies a unique place in the annals of science in America. John William Draper, author of "The Intellectual History of Europe," was a pioneer of American research, adding by his own investigations to the progress of the first half of the nineteenth century. Henry Draper, his son, an early member of the National Academy, was one of the founders of astrophysics. He was the first to photograph nebulæ and the first to secure photographs of stellar spectra of sufficiently perfect definition to show the lines. His researches, made with instruments of his own construction, are being continued on a large scale by the Harvard College observatory. Mary Anna Palmer Draper, wife of Henry Draper, and his devoted assistant in astrophysical research, has endowed the Henry Draper Memorial to continue his investigations. Her interest in the National Academy was manifested by her constant attendance at its meetings, her receptions of the academy at her home in New York, and by two important gifts. The first of these, made in 1883, established the Draper gold medal for researches in astronomical physics, and provided, through excess income, for the assistance of many investigations in this field. This gift has now been supplemented by a bequest of $25,000, to be known as the John S. Billings fund, the income of which will be applied at present toward the support of the recently established Proceedings.

The academy feels that this appropriate memorial of one of its leading members, providing funds greatly needed for a new publication, and closing a long series of exceptional services to science, will be widely and gratefully appreciated.

A copy of this resolution was directed to be forwarded to the family of Mrs. Draper.

REPORT OF THE EDITORIAL BOARD OF THE PROCEEDINGS.

The editorial board of the Proceedings reports to the academy that four numbers of the Proceedings have now been issued, containing 67 original papers in addition to the report of the autumn meeting, notices of scientific memoirs, and announcements. These numbers have consisted of 258 pages, an average of 64 pages per number and of about 4 pages per article. The papers are distributed among different sciences as follows: Mathematics, 11; astronomy, 11; physics, none; chemistry, 11; geology, 2; paleontology, 1; botany, 4; zoology (including genetics), 12; physiology, 8; pathology, none; anthropology, 5; psychology, 2. It will be noticed that the subjects of physics, of geology and paleontology, and of pathology have been very inadequately represented; and the editorial board urges members of the academy in these fields to endeavor to remedy this situation.

An edition of 3,000 copies of these four numbers has been printed. Of this edition about 900 are to be sent abroad to the libraries of universities and other active research institutions upon a mailing list prepared with great care by the foreign secretary, aided by members of the editorial board. Of this edition 1,200 copies have also been distributed in this country by the home secretary to important libraries and to the thousand persons whose names are starred in Cattell's American Men of Science.

ARTHUR A. NOYES, *Chairman.*

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REPORT OF THE COMMITTEE ON THE COLLECTION OF HISTORICAL PORTRAITS, MANUSCRIPTS, AND INSTRUMENTS, INCLUDING INSTRUMENTS PURCHASED AT THE EXPENSE OF THE TRUST FUNDS.

Your committee on the collection of historical portraits, manuscripts, and instruments, including instruments purchased at the expense of the trust funds which are no longer needed for the original purpose, begs to report as follows:

That the collection of portraits of the members of the academy has been brought together and arranged alphabetically.

That the foreign secretary has turned over the medal from the Groningen Academy celebrating its three hundredth anniversary.

That the following apparatus was presented by Mrs. Henry Draper and has been deposited in the United States National Museum:

1 slit.
1 spectrum photograph (broken).
1 liquid prism cell.
1 double liquid prism cell.
1 prism with 2-inch faces.
1 package—attempts of Henry Draper to rule gratings.
1 speculum metal ruled surface 2 inches square.
1 Bunsen burner.
2 boxes, 12 photographs each.
1 box, 50 photographs.
1 box, 34 photographs.
1 box, 22 photographs.
1 box, 15 daguerreotypes.
1 box, 7 photographs.
13 Geisler ? tubes.

CHARLES D. WALCOTT, *Chairman.*

REPORT OF THE COMMITTEE OF CHAIRMEN OF SECTIONS.

The committee of chairmen of sections of the academy recommends the following rule in regard to the nomination of members:

The chairman of each section of the academy shall submit to the members of his section, not later than November 1 of each year, a ballot containing the names of all those persons who received not less than 2 votes in the nominating ballot of the preceding year and of any other persons who were newly proposed for consideration at that time. Each member of the section shall be expected to return this ballot to the chairman within two weeks with his signature and with crosses placed against the names of those persons whom he is prepared to indorse for nomination. Each member may also write upon the ballot in a place provided for the purpose any new names which he desires to have included in the ballot to be submitted to the section in the following year. The vote resulting from this ballot shall be regarded as informal.

The chairman shall then submit to the members of his section a new ballot showing the results of the informal vote; and each member shall be expected to return this ballot to the chairman with his signature and with crosses placed against the names of those persons whom he will indorse for nomination.

The chairman shall then certify to the home secretary, prior to January 1, the names of those persons who have been voted for on this second ballot by a majority of the members of the section, and shall furnish him a list of the publications of these nominees, as required by the constitution.

A. A. NOYES, *Chairman.*

The recommendation of the committee was adopted by the academy as an amendment to Rule IV (p. 58, seq.).

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ELECTION OF MEMBERS OF THE COUNCIL.

Mr. W. H. Howell and Mr. J. M. Coulter were chosen members of the council to succeed Mr. W. T. Councilman and Mr. R. S. Woodward.

ELECTION OF NEW MEMBERS.

The following were elected members of the academy on April 21, 1915:

Henry Seely White, mathematician, Vassar College, Poughkeepsie, N. Y.

Charles Greeley Abbot, astrophysicist, Astrophysical Observatory, Smithsonian Institution, Washington, D. C.

Robert Andrews Millikan, physicist, University of Chicago, Chicago, Ill.

Alexander Smith, chemist, Columbia University, New York City.

Samuel Wendell Williston, paleontologist, University of Chicago, Chicago, Ill.

William Ernest Castle, zoologist, Harvard University, Cambridge, Mass.

Frank Rattray Lillie, zoologist, University of Chicago, Chicago, Ill.

Graham Lusk, physiologist, Cornell University Medical College, New York City.

Victor Clarence Vaughan, pathologist, University of Michigan, Ann Arbor, Mich.

Granville Stanley Hall, psychologist, Clark University, Worcester, Mass.

CONSTITUTION OF THE NATIONAL ACADEMY OF SCIENCES.

The draft of the constitution as amended and unanimously adopted in the committee of the whole at the Chicago meeting, printed in full on pages 30–37, Annual Report for 1914, was presented by the president as chairman of the committee of the whole, and adopted.

RULES.

The rules revised and arranged in groups to correspond with the articles and sections of the new constitution were presented and adopted as printed on pages 56–61 of this report.

ANNOUNCEMENTS OF COMMITTEE PERSONNEL.

The president announced the appointment of the following new members of standing committees:

The Henry Draper fund: J. S. Ames in place of A. W. Wright.

The J. Lawrence Smith fund: E. C. Pickering to succeed Raphael Pumpelly.

The Comstock fund: Elihu Thomson to succeed himself.

The Murray fund: W. H. Dall to succeed himself.

The Marcellus Hartley fund: George F. Becker, appointed chairman in place of Elihu Thomson, resigned; Theobald Smith to succeed Elihu Thomson, resigned.

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ANNOUNCEMENT OF THE AUTUMN MEETING.

The president announced that an invitation had been received from the members of the academy living in New York City asking that the autumn meeting be held there, and that this invitation had been accepted.

SCIENTIFIC SESSIONS.

The following program of scientific sessions was carried out in full at the annual meeting of the National Academy of Sciences, 1915:

PROGRAM, ANNUAL MEETING, APRIL 19, 20, 21, 1915.

Monday, April 19, 1915.

[2.30 p. m.—Auditorium, National Museum.]

Thomas H. Morgan: Localization of the hereditary material in germ cells. (30 minutes.)

PROBLEMS OF NUTRITION AND GROWTH.

Jacques Loeb: Stimulation of growth. (30 minutes.)

Lafayette B. Mendel: Specific chemical aspects of growth. (30 minutes.)

Eugene F. Du Bois, medical director, Russell Sage Institute of Pathology (by invitation of the program committee): Basal metabolism during the period of growth. (30 minutes.)

I. S. Kleiner and S. J. Meltzer: Retention in the circulation of injected dextrose in depancreatized animals and the effect of an intravenous injection of an emulsion of pancreas upon this retention. (10 minutes.)

[8 p. m.—Auditorium, National Museum.]

First William Ellery Hale lecture, by Thomas Chrowder Chamberlin, of the University of Chicago. Subject: The evolution of the earth. (Illustrated.)

The lecture will be followed by a conversazione in the art gallery of the Museum. All members of the scientific societies of Washington, with ladies, are cordially invited to attend both lecture and conversazione. No cards are necessary.

Tuesday, April 20, 1915.

[10 a. m.—Auditorium, National Museum.]

Joel Stebbins, Draper medallist: The electrical photometry of stars. (30 minutes, illustrated.)

George E. Hale: A vortex hypothesis of sun spots. (20 minutes, illsutrated.)

Edwin B. Frost: The spectroscopic binary, mu orionis. (10 minutes, illustrated.)

Robert W. Wood: One-dimensional gases and the experimental determination of the law of reflection for gas molecules. (10 minutes, illustrated.)

Robert W. Wood: The relations between resonance and absorption spectra. (15 minutes, illustrated.)

Edward L. Nichols and H. L. Howes: On the polarized fluorescence of ammonio-uranyl chloride. (15 minutes, illustrated.)

Robert A. Millikan (by invitation of the program committee): Atomism in modern physics. (30 minutes, illustrated.)

[2.30 p. m.—Auditorium, National Museum.]

William Morris Davis: Problems associated with the origin of coral reefs, suggested by a Shaler memorial study of the reefs of Fiji, New Caledonia, Loyalty Islands, New Hebrides, Queensland, and the Society Islands, in 1914. (60 minutes, illustrated.)

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F. W. Clarke: Inorganic constituents of marine invertebrates. (15 minutes.)

Roy L. Moody (introduced by H. F. Osborn): Amphibia and reptilia of the American Carboniferous. (15 minutes, illustrated.)

Henry Fairfield Osborn and J. Howard McGregor: Human races of the old stone age of Europe, the geologic time of their appearance, their racial and anatomical characters. (15 minutes, illustrated.)

Charles A. Davis, geologist, Bureau of Mines (by invitation of the program committee): On the fossil algæ of the petroleum-yielding shales of the Green River formation. (15 minutes, illustrated.)

Nathaniel L. Britton: The forests of Porto Rico. (10 minutes.)

J. Walter Fewkes: Pictures on prehistoric pottery from the Mimbres Valley in New Mexico and their relation to those of Casas Grandes. (20 minutes, illustrated.)

Charles B. Davenport: Inheritance of temperament. (15 minutes.)

Charles B. Davenport: Inheritance of Huntington's chorea. (12 minutes.)

E. E. Barnard: A singular dark marking on the sky. (5 minutes, illustrated.)

E. W. Brown (introduced by R. S. Woodward): Biographical memoir of George William Hill. (Read by title.)

Wednesday, April 21, 1915.

[2.45 p. m.—Auditorium, National Museum.]

George H. Parker, official representative of the academy upon the special commission appointed by the President of the United States to study and report upon the Alaskan fur seals during the summer of 1914. Subject: The fur-seal herd of the Pribilof Islands. (Illustrated.)

[4 p. m.—Auditorium, National Museum.]

Second William Ellery Hale lecture, by Thomas Chrowder Chamberlin, of the University of Chicago. Subject: The evolution of the earth. (Illustrated.)

PRESENTATION OF THE HENRY DRAPER MEDAL.

At the annual dinner of the Academy, held at the Hotel Raleigh April 20, 1915, the Henry Draper medal, provided by the Henry Draper fund, was awarded to Joel Stebbins, of the University of Illinois, in recognition of his work on application of the selenium cell to stellar photometry.

AUTUMN MEETING.

The autumn meeting of the academy was held in the American Museum of Natural History at New York City, on November 15, 16, 17, 1915. Forty-eight members were present, as follows: Abbot (C. G.), Becker, Boas, Boltwood, Britton, Castle, Cattell, Chittenden, Clark (W. B.), Clarke (F. W.), Clarke (J. M.), Conklin, Coulter, Crew, Cross, Davenport, Day, Donaldson, Hague, Harper, Harrison, Hillebrand, Holmes, Howell, Iddings, Lindgren, Loeb, Lusk, Mall, Mendel, Michelson, Morgan, Morse, Noyes (A. A.), Osborn (H. F.), Osborne (T. B.), Pickering, Ransome, Reid, Richards, Rosa, Schuchert, Smith (Theobald), Van Hise, Walcott, Webster, Wheeler, White, (H. S.).

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BUSINESS SESSION.

The home secretary made the following announcements:

DEATHS SINCE THE ANNUAL MEETING.

Members.—John Ulric Nef, elected 1904, died August 13, 1915; Frederick W. Putnam, elected 1885, died August 18, 1915.

Foreign associates.—Theodor Boveri, elected 1913, died October 15, 1915; Paul Ehrlich, elected 1904, died August 20, 1915.

PUBLICATIONS ISSUED SINCE THE LAST ANNUAL MEETING.

Proceedings, volume 1, numbers 1–11.

Memoirs, volume 12, part 2, memoirs 2 and 3, volume 13, as follows:

Volume 12, part II. Second memoir, Charles C. Adams: The variations and ecological distribution of the snails of the genus Io.

Third memoir, Joseph E. Pogue: The Turquois; a study of its history, mineralogy, geology, ethnology, archæology, mythology, folklore, and technology.

Volume 13, Oliver Cummings Farrington: Catalogue of the meteorites of North America to January 1, 1909.

Biographical memoirs: John Huntington Crane Coffin, by G. C. Comstock; Miers Fisher Longstreth, by Rebecca C. Longstreth; Charles Anthony Schott, by Cleveland Abbe; Henry Morton, by Edward L. Nichols; John Wesley Powell, by William M. Davis; Peter Lesley, by William M. Davis.

COMMITTEE CHANGES.

The election of Edwin B. Frost to be chairman of the board of directors of the Bache fund, and of Arthur Gordon Webster to succeed Ira Remsen as a member of the board.

The board is now constituted as follows:

E. B. Frost, chairman; A. G. Webster, R. G. Harrison.

The election of Theodore William Richards to succeed Ira Remsen as a member of the board of directors of the Wolcott Gibbs fund.

The board is now constituted as follows:

C. L. Jackson, chairman; T. W. Richards, Edgar F. Smith.

The ad interim appointments of acting chairmen of the sections of the academy are as follows:

Mathematics: E. H. Moore, acting chairman.

Astronomy: G. C. Comstock, acting chairman.

Physics and Engineering: R. S. Woodward, acting chairman.

Chemistry: A. A. Noyes, acting chairman.

Geology and Paleontology: Arnold Hague, acting chairman.

Botany: J. M. Coulter, chairman, 1915–1918.

Zoology and Animal Morphology: E. G. Conklin, acting chairman.

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The ad interim appointments of acting chairmen—Continued.
Physiology and Pathology: R. H. Chittenden, acting chairman.
Anthropology and Pscyhology: W. H. Holmes, acting chairman.

The following members were appointed a committee to audit the accounts of the treasurer in accordance with Rule V, 5: William H. Dall, chairman; Arthur L. Day, F. W. Clarke.

The division of the members of the editorial board of the Proceedings into three groups, one-third of them retiring annually, in accordance with Rule V, 1 was announced as follows:

December 1, 1916.—W. B. Cannon, J. McK. Cattell, J. M. Coulter, Simon Flexner, R. G. Harrison.

December 1, 1917.—C. B. Davenport, E. G. Conklin, E. B. Frost, W. H. Holmes, E. H. Moore.

December 1, 1918.—J. M. Clarke, J. J. Abel, R. A. Millikan, Alexander Smith, J. P. Iddings.

DELEGATES.

Mr. Arthur L. Day represented the National Academy at the inauguration of Dr. F. J. Goodnow as president of Johns Hopkins University and at the dedication of the new University buildings on March 20, 1915.

Mr. T. H. Morgan represented the National Academy at the fiftieth anniversary of Vassar College and the inauguration of Dr. H. N. MacCracken as president on October 13, 1915.

COMMITTEE ON PANAMA CANAL.

The president announced that in accordance with the request of the President of the United States he had appointed the following a committee of the academy to consider and report upon the possibility of controlling the slides which are seriously interfering with the use of the Panama Canal: C. R. Van Hise, chairman; H. L. Abbot, G. F. Becker, J. C. Branner, Whitman Cross, Arthur L. Day, J. F. Hayford, H. F. Reid, R. S. Woodward, R. C. Carpenter, Arthur P. Davis, John R. Freeman.

MARSH FUND.

The treasurer reported that Mr. W. W. Farnam, executor of the estate of O. C. Marsh, deceased, had transmitted to the academy on July 23, 1915, the final payment of $750, completing the legacy of $10,000 left by Mr. Marsh to the National Academy of Sciences.

CONSOLIDATION OF FUNDS.

The treasurer reported that the plan for the consolidation of certain funds of the academy for investment purposes had been approved by the fiscal advisers of the academy, Messrs. Spencer Trask

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& Co., of New York, and the American Security & Trust Co., of Washington, D. C., and that by direction of the council the contemplated consolidation of the investments would be completed about February 1, 1916.

REPORT OF THE COMMITTEE ON THE HENRY DRAPER FUND.

The committee on the Henry Draper fund recommends to the academy that the following appropriations be made from available income:

Four hundred dollars to Dr. Frank Schlesinger, director of the Allegheny observatory, to be applied toward the construction of a machine for measuring astronomical photographs.

Three hundred dollars to Dr. Joel Stebbins, director of the University of Illinois observatory, to be used in the further development of the photo-electric photometer and its application to the study of variable stars.

Two hundred dollars to be applied toward the expense of publishing the Proceedings of the National Academy.

GEORGE E. HALE,
Chairman.

NAME OF THE ACADEMY.

The following motion was approved by the academy:

That on the title page of the Proceedings and of other publications of the academy, where permissible, the legal title, National Academy of Sciences, be followed by the words "of the United States of America."

REPORT OF THE COMMITTEE ON THE MEDAL FOR EMINENCE IN THE APPLICATION OF SCIENCE TO THE PUBLIC WELFARE.

As no names of candidates were laid before the academy at the autumn meeting in 1914, the money available for making medals will be added to the principal of the Marcellus Hartley fund.

At the stated meeting in April Mr. Thomson expressed by letter a desire to be relieved, and I was appointed chairman.

The committee recommends to the academy that the medal for eminence in the application of science to the public welfare be conferred by the academy at its annual meeting in 1916 upon Mr. Cleveland Abbe and Mr. Gifford Pinchot.

In 1868 Mr. Cleveland Abbe was appointed director of the Cincinnati Observatory. On September 1, 1869, he inaugurated daily weather reports for the Cincinnati Chamber of Commerce. The favor with which the Cincinnati observations were received was brought to the attention of Congress, which passed a joint resolution in February, 1870, directing the Secretary of War to provide for weather observations. In January, 1871, Gen. Meyer was directed to take charge of the new weather bureau, and he appointed Abbe his meteorologist. In the first year Abbe in person did all the work of collating and tabulating. He remained in the Signal Service until 1891, when the United States Weather Bureau was inaugurated under the Department of Agriculture, and in this bureau he has served ever since. It is apparent that the weather service of the United States owes its origin and a very large part of its efficiency to Mr. Abbe. It is unnecessary to call attention to the fact that the warnings sent out by this service have saved great numbers of lives and vast sums of money. The attempts to predict the weather on scientific principles were at first met in Europe by ridicule, but most of the European countries have since established bureaus of the same description, all of which is due to Abbe.

As to the work of Mr. Gifford Pinchot, it is so recent and well known that a few words will suffice. Only a few years ago the tendency in the United States to squander

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its natural resources was lamentable. Mr. Pinchot's efforts brought about the reaction in favor of conservation, finding earnest support and sympathy from Mr. Roosevelt during his first presidential term.

Mr. Pinchot's efforts were at first confined to forest reserves, these being in his own charge, but his public and private warnings and arguments have led to greatly increased caution in the expenditure of the national capital.

GEORGE F. BECKER,
Chairman.

AWARD OF THE MEDAL FOR EMINENCE IN THE APPLICATION OF SCIENCE TO THE PUBLIC WELFARE.

Upon recommendation of the committee on the medal for eminence in the application of science to the public welfare and the indorsement of the council, the academy voted to award two medals at its annual meeting in 1916.

To Mr. Cleveland Abbe, member of the academy, for distinguished public service in establishing and organizing the Weather Service of the United States.

This is the first award of this medal to a member of the academy.

To Mr. Gifford Pinchot for distinguished public service in organizing and directing the movement for the systematic conservation of the natural resources of the United States.

REPORT OF THE EDITORIAL BOARD OF THE PROCEEDINGS.

The editorial board of the Proceedings presents the following brief report of the progress during the past year:

The first 10 issues of the Proceedings have consisted of 562 pages. In the numbers have been presented reports of the spring meeting, notices of the scientific and biographical memoirs published by the academy, and 141 original papers averaging very nearly four pages in length. These articles have been distributed among the different sciences as follows: Astronomy, 29; mathematics, 19; chemistry, 18; physiology, 16; genetics, 14; anthropology, 11; zoology, 10; physics, 7; botany, 4; geology, 4; psychology, 2; various other sciences, 1 or 2 each.

Two well-attended meetings of the editorial board have been held during the year, at which plans were discussed of increasing the number of contributions to the Proceedings, of enlarging their circulation, and of improving the character of the journal. A foreign mailing list, including 905 names, has been prepared by the foreign secretary, with the cooperation of the editors, and the Proceedings are being circulated in accordance with this list.

A statement from the treasurer shows that the cost of printing and distributing the first 10 numbers of the Proceedings has been $2,466.04, and that the other charges on the proceedings account from January 1, 1915, to November 9, 1915, have amounted to $1,188.30.

ARTHUR A. NOYES, *Chairman.*

NEW RULE REPLACING RULE IV, 1.

Upon recommendation of the council the following amendment to the rules of the academy was adopted:

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Rule IV, 1, to read:

"The term of service of each chairman of a section shall be three years, to date from the closing session of the April meeting next following his election. Chairmen of sections shall be chosen by mail ballot, the member receiving the highest number of votes cast to be deemed elected. It shall be the duty of each retiring chairman to conduct the election of his successor and to report the result of the election to the home secretary before the April meeting at which his term of service expires. Should any section fail to elect a chairman before November 1, the president is empowered to appoint a temporary chairman to serve until the April meeting next following. No chairman shall be eligible for reelection for two consecutive terms."

SCIENTIFIC SESSIONS.

Following is the program of the scientific sessions at the New York meeting:

AMERICAN MUSEUM OF NATURAL HISTORY.

Monday, November 15.

[8 p. m.—Auditorium, first floor.]

MICHAEL IDVORSKY PUPIN: The problem of aerial transmission.

Tuesday, November 16.

[10.30 a. m.—West Assembly Hall, first floor.]

EDWIN G. CONKLIN: Nature of cell polarity.

W. E. CASTLE: Is selection or mutation the more important agency in evolution?

A. E. VERRILL: Inheritance of clubbed feet through five known generations; inheritance of abnormal or defective thumbs through four known generations.

CHAS. B. DAVENPORT: Heredity of stature.

E. C. MACDOWELL (introduced by Chas. B. Davenport): Parental alcoholism and mental ability—a comparative study of habit formation.

JAMES B. MURPHY (introduced by Jacques Loeb): Rôle of the lymphocytes in resistance to cancer.

GRAHAM LUSK: The colorimeter as an interpreter of life processes.

T. B. OSBORNE and LAFAYETTE B. MENDEL: The resumption of growth after failure to grow.

W. H. HOWELL: Ultramicroscopic studies of the fibrin-gel.

C. WILLIAM BEEBE (introduced by Henry Fairfield Osborn): Origin of the flight of birds.

FRANK M. CHAPMAN (introduced by Henry Fairfield Osborn): Ornithological survey of the Andes and western coast of South America.

DOUGLAS HOUGHTON CAMPBELL: Treubia.

MARSHALL A. HOWE (introduced by N. L. Britton): Fossil calcareous algae from the Panama Canal Zone with reference to reef-building algae.

A. B. STOUT (introduced by N. L. Britton): Sterility in plants and its inheritance.

J. N. ROSE (introduced by N. L. Britton): Recent explorations in the cactus deserts of South America.

GEORGE H. SHULL (introduced by Chas. B. Davenport): Some factors affecting the inheritance ratios in shepherd's purse.

HERBERT M. RICHARDS (introduced by R. A. Harper): The respiratory ratio of cacti in relation to their acidity.

R. A. HARPER: Some studies in morphogenesis.

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[2.30 p. m.—West Assembly Hall, first floor.]

HERBERT S. JENNINGS: Can we observe organic evolution in progress?

JOHN M. COULTER: Orthogenesis in plants.

THEODORE W. RICHARDS: Investigations recently conducted in the Wolcott Gibbs Memorial Laboratory.

B. B. BOLTWOOD: The life of radium.

Wednesday, November 17.

[10.30 a. m.—West Assembly Hall, first floor.]

ALFRED G. MAYER and ROBERT S. WOODWARD (by title): The biography of Alfred Marshall Mayer.

C. G. ABBOT: The solar radiation and its variability.

A. G. WEBSTER: Experiments and theory of conical horns; instruments for measurements of sound; an instrument for finding the direction of a fog signal.

EDWARD C. PICKERING: The New Draper Catalogue.

HENRY NORRIS RUSSELL (introduced by Edward C. Pickering): On the albedo of the moon and planets.

GEORGE F. BECKER: A possible origin for some spiral nebulae.

L. A. BAUER (introduced by R. S. Woodward): Concomitant changes in the earth's magnetism and solar radiation.

FRED E. WRIGHT and J. C. HOSTETTER (introduced by Arthur L. Day): Experiments on the mean free path of gases; observations on Wood's one-dimensional gas.

JAMES KENDALL (introduced by Alexander Smith): The water correction in conductivity determinations.

HENRY FAIRFIELD OSBORN: Extremes of adaptation in carnivorous dinosaurs, tyrannosaurus and ornithomimus.

C. K. LEITH (introduced by C. R. Van Hise): The influence of certain minerals on the development of schists and gneisses.

W. M. DAVIS: Glacial sculpture of the Mission Range, Montana.

WALDEMAR LINDGREN: Crystallization of quartz veins.

E. W. HILGARD: A peculiar clay from near the City of Mexico.

GEORGE P. MERRILL (introduced by Arthur L. Day): The minor constituents of meteorites (by title).

DECEASED MEMBERS.

FREDERIC WARD PUTNAM.

The following minute on the life and services of Prof. Putnam was placed upon the records of the faculty of arts and sciences of Harvard University at the meeting of October 26, 1915:

Frederic Ward Putnam, son of Ebenezer and Elizabeth Appleton Putnam, was born in Salem, Mass., April 16, 1839, and died August 18, 1915. His ancestors on both sides were early immigrants from England, the first American ancestor being John Putnam, who settled in Salem in 1640. The father, grandfather, and great-grandfather of Prof. Putnam were all graduates of Harvard College, and the associations of his mother's family had been close with the institution from its beginning.

His early schooling was received in private schools and at home under his father's tuition. At an early age he showed great interest

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in natural history and had thoughts of devoting himself to scientific pursuits. Promised an appointment at West Point, however, he was preparing himself to adopt a military career when Louis Agassiz met him at the museum of the Essex Institute and, recognizing in him a keen student, persuaded him to take up natural history as his life work. His preparation for the military profession was accordingly abandoned, and he devoted himself at once to the study of birds, being made curator of ornithology in the Essex Institute in 1856. In the following year he was made assistant to Prof. Agassiz, and entering the Lawrence Scientific School received the degree of S. B. in 1862. For a number of years after this he continued his work in the study of animal life as curator of vertebrates at the Essex Institute, of ichthyology at the Boston Society of Natural History, and as assistant in the museum of comparative zoology at Harvard University. During these years he had also some experience in museum administration, as he was entrusted with the charge of the museum of the Essex Institute and of the museum of the East Indian Marine Society in Salem, and later was made director of the museum of the Peabody Academy of Science in the same city. In 1873 he was chosen to fill the important position of permanent secretary of the American Association for the Advancement of Science, an office which he held for 25 years. Prof. Putnam's connection with the association lasted through one of the most important periods in its life, and to his energy and administrative ability much of its success was due.

Although it was in the field of natural history that Prof. Putnam for many years carried on most of his work, his interest in archeology was early aroused. While attending the meeting of the American Association at Montreal in 1857 he discovered on Mount Royal a small kitchen-midden, and was thus among the very first in this country to recognize the presence of the remains of prehistoric man. In 1874 Dr. Jeffries Wyman, the first curator of the Peabody Museum of American Archeology and Ethnology, died, and Prof. Putnam was appointed to take the place. This began his connection with the institution of which he was the director for over 40 years. In 1886 he was made Peabody professor of American archeology and ethnology and served as such until 1909, when he joined the group of the emeriti. During the nearly half century of his connection with the museum he labored unceasingly to build up its collections, both by purchase and by explorations in the field. He was one of the earliest to realize the need of archeological and anthropological exploration and to insist that careful field notes and data are equally important with the specimens themselves. The great collections which he gathered and which place the museum in the forefront of the museums of this country are a witness of his success.

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With the appointment to the Peabody professorship, Harvard University became one of the first institutions in the country to offer instruction in the field of anthropology and American archeology. Although always more active in museum and field work than in teaching, Prof. Putnam strove constantly to develop the instruction in his chosen science from the time when, before any courses were offered, he had several voluntary students working under his direction, to the very last days of his life, when nearly a score of specialized courses were offered by the division of which he had for so long been the head.

Striking as were the results of his work here at Harvard, his influence was literally nation wide, and he may justly be called one of the fathers of anthropology in America, the others being Brinton, of Pennsylvania, and Powell, of Washington. In 1892 he was made chief of the department of anthropology at the World's Columbian Exposition at Chicago, and not only brought together what was probably the greatest archeological and anthropological exhibit ever gathered in this country up to that time, but collected by the aid of numerous collaborators a vast mass of data in regard to our native peoples which has not yet been fully worked up. The specimens so brought together for the exposition became the nucleus of the present Field Museum of Natural History, which may thus be regarded as, in its origins, of his making. In 1894 Prof. Putnam was made curator of anthropology in the American Museum of Natural History in New York City, and for nearly 10 years he applied to its administration and to the building up of its collections the experience he had gained in Cambridge and Chicago. It was again largely through his efforts that the University of California established a department of anthropology in 1903, and he held the position of professor of anthropology and director of the anthropological museum in that institution until his retirement in 1909.

In his long life of scientific work a great deal of Prof. Putnam's attention was necessarily devoted to administrative and editorial duties, but he found time, nevertheless, for the writing of a large number of scientific papers, and the bibliography appended to the anniversary volume presented to him in 1909 by his associates and students, contains something over 400 titles. His membership in scientific societies, both at home and abroad, was extensive. In this country he was a member of the National Academy of Sciences, the American Academy of Arts and Sciences, the American Philosophical Society, and a great many others; outside the United States he was an honorary or corresponding member of the anthropological societies of Great Britain, Paris, Stockholm, Berlin, Rome, Florence, and Brussels, of the Royal Society of Edinburgh, and others of minor

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importance. In 1868 he received the degree of A. M. from Williams College; in 1894 the degree of S. D. from the University of Pennsylvania; and in 1896 the Cross of the Légion of Honor from the French Government.

Prof. Putnam was twice married: In 1864 to Adelaide Martha Edmands, of Cambridge, by whom he had three children, two daughters and one son. After her death, 15 years later, he married in 1882 Ester Orne Clarke, of Chicago, who, with his three children, survives him.

To his students and associates Prof. Putnam endeared himself by his kindliness and sympathy. For every one he had a cordial greeting and a pleasant word. He was ready always to give unstintedly of his time, and so far as he was able, from his pocket, to anyone who asked his aid. He had the gift of inspiring those with whom he came in contact with enthusiasm for research, and to few is it given to have so wide an influence. Until the very last years the great majority of those in this country who were working in the anthropological field had been associated more or less closely with Prof. Putnam, either as students or colleagues in the various institutions of which he he had been a member. His loss, therefore, is widely felt, not only because he was an able administrator and the last of the three founders of anthropological study in this country but also because he had won the affections of so many as a teacher and a friend. (Extract from Science, n. s., vol. 42, p. 638.)

PAUL EHRLICH.

Paul Ehrlich was a genius of the first order. He was born in Strehlen, Germany, March 14, 1854, and died at Frankfort-on-the-Main August 20, 1915. While he was still a student of medicine, the problems presented by the affinity of lead for certain tissues attracted his attention. From speculating on the nature of this affinity, his interest grew to include protoplasmic affinities in general, and thus was determined the direction his genius should take.

Some of the notable results of his early investigations are discoveries in bacterial staining methods, which proved of great value to Koch and which, ever since, have been in daily use everywhere; the microchemical differentiation of leukocytes, on which rests the study of the blood for clinical purposes; the development of the methylene blue reaction on living tissues, and the formulation of that unique conception of protoplasmic structure and function on which he based the great side-chain theory which he advanced to explain the reactions in immunity and other phenomena.

What might be termed the second phase of Ehrlich's work concerned investigations in immunity under the guidance of the side-

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chain conception. No better illustration of the practical usefulness of the imagination in creating a successful working hypothesis can be given than the results achieved by Ehrlich in the field of immunity. Perhaps the usefulness is seen most clearly in the standardization of diphtheria antitoxin, which was a direct outcome of experiments devised according to the side-chain idea. Ehrlich's method, to the exclusion of others, is used all over the world; but the influence of the work carried out to his pupils still dominates investigation in all branches of immunity and the practical use of the knowledge obtained therefrom.

The side-chain theory is so well known that it is not necessary to restate it except in the most succinct form. A toxin or other antigen is without action on the animal body unless bound by molecular chains in the cells—receptors. But when so bound, the antigen causes injury to the cell, and subsequent repair, in the course of which there is an overproduction of receptors, which, passing into the blood and lymph, constitute the antibody for the antigen in question, because the antigen is now bound and neutralized or destroyed before it can reach the cell. As expressed by Behring, antibodies are free cell receptors, and the elements which, when situated in the cells, are essential for the action of toxins, for instance, are also the means of healing when free in the blood. In accord with the principles of this theory, Ehrlich's vivid mind coined numerous new words, which proved helpful in the discussion of new facts and ideas, and which soon passed into current international usage.

Ehrlich's last work was the development of the experimental chemotherapy of syphilis and certain other spirochetal infections. To discuss this wonderful work fully in all its ramifications is not possible at this time. The scientific world has accepted "the development through a lengthy series of systematic biochemical experiments, based on original conceptions of the affinities of cellular constituents, of a successful chemotherapy of important human infections, by direct attack on the parasites by substances specially built up for that purpose and introduced from without," as the fitting culmination of the tireless activities of an altogether unique investigative spirit. As pointed out elsewhere, Ehrlich's results in experimental chemotherapy fully justify Huxley's prediction in 1881 that through discoveries in therapeutics it would become possible "to introduce into the economy a molecular mechanism which, like a cunningly contrived torpedo, shall find its way to some particular group of living elements and cause an explosion among them, leaving the rest untouched.

Paul Ehrlich will live in the history of civilization as one of the great investigators, genial, creative, fertile, excelling in "that bold-

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ness of the scientific use of the imagination which alone can extend beyond the obvious fact and reveal the unknown," one of the great benefactors of mankind.

He was elected a foreign associate of the National Academy of Sciences in 1904.

(Extract from Science, n. s., vol. 42, p. 332.)

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ANNUAL REPORT OF THE TREASURER.

JANUARY 1 TO DECEMBER 31, 1915.

To the PRESIDENT OF THE NATIONAL ACADEMY OF SCIENCES:

SIR: I have the honor to submit the following report as treasurer for the fiscal year, January 1 to December 31, 1915. Before presenting the detailed statements of the report, some special features of the financial transactions of the year will be mentioned:

The income of the academy during the year, from dues, investments, subscriptions to Proceedings, contributions to the Proceedings fund and William Ellery Hale lectureship, was $15,685.03; the expenditures, exclusive of investments, amounted to $9,115.34.

The sum of investments held by the academy on December 31 was $228,071.85 (price paid), yielding on that date at the rate of 4.98 per cent. The total income from investments received during the year was $11,476.31.

Changes in investments may be summarized as follows: Eight first-mortgage notes on real estate, amounting to $8,000, were paid in full, one was curtailed by the payment of $1,000, and one bond of $1,000 was called and paid; bonds were purchased to the amount of $8,307.50 (face value, $8,500).

The academy has now received the full amount of $10,000, bequeathed to it by the late O. C. Marsh, the final payment of $750 having been received during the year.

The special fund contributed by members and friends of the academy toward the expenses of the publication of the Proceedings amounts to $1,148.70.

Payments made on grants from various funds, in aid of research and for medals, amounted to $6,915.56.

TRUST FUNDS OF THE ACADEMY.

The trust funds of the academy, the income of which is administered for specific purposes, are enumerated below. The capital of certain funds has been increased beyond the amount of the original gift or bequest, by the transfer of accumulated income, at the request of the donors or by action of the academy.

Bache fund: Bequest of Alexander Dallas Bache, a member of the academy, 1870. To aid researches in physical and natural sciences..... $56,000.00

Watson fund: Bequest of James C. Watson, a member of the academy, 1874. For the promotion of astronomical science through the award of the Watson gold medal and grants of money in aid of research..... 25,000.00

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Draper fund: Gift of Mrs. Henry Draper, 1883, in memory of her husband, a former member of the academy. To found the Henry Draper gold medal, to be awarded for notable investigations in astronomical physics. The balance of income is applied to aid research in the same science.... $10,000.00

Smith fund: Gift of Mrs. J. Lawrence Smith, 1884, in memory of her husband, a former member of the academy. To found the J. Lawrence Smith gold medal, to be awarded for important investigations of meteoric bodies and to assist, by grants of money, researches concerning such objects..... 10,000.00

Gibbs fund: Established by a gift of Wolcott Gibbs, a member of the academy, 1892, and increased by a bequest of the late Morris Loeb, 1914. For the promotion of researches in chemistry 5,500.00

Gould fund: Gift of Miss Alice Bache Gould, 1897, in memory of her father, a former member of the academy. For the promotion of researches in astronomy..... 20,000.00

Comstock fund: Gift of Gen. Cyrus B. Comstock, a member of the academy, 1907. To promote researches in electricity, magnetism or radiant energy, through the Comstock prize, of money, to be awarded once in five years for notable investigations. The fund is to be increased ultimately to $15,000..... 11,337.50

Marsh fund: Bequest of Othniel Charles Marsh, a member of the academy, 1909. To promote original research in the natural sciences..... 10,127.65

Murray fund: A gift from Sir John Murray, 1911, to found the Alexander Agassiz gold medal, in honor of a former member and president of the academy, to be awarded for original contributions to the science of oceanography..... 6,000.00

Hartley fund: A gift from Mrs. Helen Hartley Jenkins, 1913–14, in memory of her father, Marcellus Hartley, to found the medal of the academy awarded for eminence in the application of science to the public welfare..... 1,168.00

The sum of $1,168 is the balance of the original gift left after defraying all expenses of the first award of this medal. By action of the academy, the fund will be increased to $1,200 from accumulated income.

In addition to the above-named trust funds the academy holds the following:

Agassiz fund: Bequest of Alexander Agassiz, a member of the academy, 1910, for the general uses of the academy..... $50,000.00

Building fund: A gift from Alexander Agassiz and Theodore N. Gill, former members of the academy, together with accumulated income, toward a building for the academy..... 8,957.02

CONDENSED STATEMENT OF RECEIPTS AND EXPENDITURES, 1915.

RECEIPTS.

Balance, Jan. 1, 1915, as per last report.....	$11,281.00
Total income from investments during 1915.....	11,476.31
Annual dues:	
1913.....	5.00
1914.....	30.00
1915.....	645.00
Interest on bank deposits.....	211.80
William Ellery Hale lectureship	1,000.00

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Refund from general fund to Hale lectureship	$95.62
Return from Hale lectureship to general fund	495.62
Contributions to Proceedings	1,990.00
Subscriptions to Proceedings	538.72
Reprints and separate numbers of Proceedings	376.81
Addition to Marcellus Hartley fund	75.00
Mortgage notes paid	9,000.00
Bond called in	1,000.00
Return from Murray fund to general fund	300.00
Return unexpended balance B. O. Peirce grant, No. 175, to Bache fund	325.03
Balance of bequest from estate of O. C. Marsh	750.00
	39,595.91

EXPENDITURES.

Investment of capital		6,852.50
Investment of income		1,455.00
Accrued interest, account changes of investments		110.36
Payments from trust and other special funds:		
Bache fund—		
R. W. Hegner	$159.96	
J. Voûte	401.00	
H. H. Lane	500.00	
E. J. Werber	230.00	
H. S. Jennings	200.00	
H. W. Norris	100.00	
P. W. Bridgman	500.00	
Draper fund—		
Joel Stebbins (medal)	214.60	
W. W. Campbell	500.00	
S. A. Mitchell	250.00	
Frank Schlesinger	400.00	
Gibbs fund—		
Mary E. Holmes	100.00	
Gould fund—		
Astronomical Journal	1,000.00	
R. W. Wood	200.00	
A. Van Maanen	100.00	
Hale lectureship—		
T. C. Chamberlin honorarium	300.00	
Return to general fund	495.62	
M. Hartley fund—		
Balance on dies and two medals	432.00	
Murray fund—		
Agassiz medal—Return to general fund	300.00	
Smith fund—		
S. A. Mitchell	500.00	
Watson fund—		
A. O. Leuschner	480.00	
J. E. Mellish	300.00	
John A. Miller	380.00	
Mrs. A. H. Watson	100.00	
		8,143.18

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General expenses:		
Bache fund—		
Printing blank applications	$8.75	
Proceedings—		
Salary, managing editor	750.00	
Printing and distributing	2,977.37	
Expenses, office of editor	315.70	
Miscellaneous expenses	257.60	
General fund—		
Salary, assistant secretary and treasurer	600.00	
Treasurer's office (auditing, bond, printing, etc.)	125.00	
Home secretary's office (clerical help, printing constitution, lists of members, circulars, etc.)	688.10	
Foreign secretary's office	66.01	
Memoirs, printing, etc	1,266.84	
Refund to Hale lectureship fund	95.62	
Meetings—		
Annual meeting, lunches, etc	639.33	
Postage and telegrams	61.75	
Election of members (printing diplomas, etc.)	35.65	
		$7,887.72
Cash balance in bank, Dec. 31, 1915:[1]		
Cash income balance		12,228.35
Uninvested capital		2,918.80
		39,595.91

Unpaid dues: 1914, $10; 1915, $70; total, $80.

STATEMENTS OF ASSETS AND LIABILITIES, DECEMBER 31, 1915.

ASSETS.

1. Mortgage notes, secured by first mortgages on real estate		$105,750.00
2. Bonds, giving name, face value, rate of interest, and cost:		
12 Broadway Realty Co. first, 5 per cent gold, due Sept. 1, 1926. Purchase money. 12 at $1,000. Nos. 38, 50, 796, 963–5, 1068, 1616–20	$12,335.00	
10 Bush Terminal Building Co. first-mortgage 50-year sinking fund, 5 per cent gold bonds, due Apr. 1, 1960. 10 at $1,000. Nos. 1383–7 and 2805–9	9,850.00	
5 Chesapeake & Ohio general mortgage, 4.5's, gold bonds, due Mar. 1, 1992. 5 at $1,000. Nos. 15350, 15351, 15352, 15353, 15354	4,556.25	
4 City of Tacoma Green River special water fund No. 2, 5 per cent, due Oct. 1, 1939. 4 at $1,000, Nos. 1508, 1509, 1510, 1511	4,150.60	
7 Cleveland Electric & Illuminating Co. first-mortgage 5 per cent gold bonds, due Apr. 1, 1939. 4 at $500 and 3 at $1,000 each. Nos. M6060, M6096, M6097, D261, D262, D263, D264	5,100.00	
20 Cosmos Club 4.5 per cent bonds, due July 1, 1949. 20 at $1,000. Nos. 286–299, 301–305, 350	20,000.00	
7 Detroit Edison Co. 5's, first mortgage, 30-year gold, due Jan. 1, 1933. 7 at $1,000. Nos. 557, 2442, 2443, 3024, 3252, 3253, 8086	7,180.00	

[1] Two outstanding checks, $63.33.

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2. Bonds, etc.—Continued.		
5 Dominion Coal Co. (Ltd.) first-mortgage sinking-fund gold bonds, 5 per cent, due May 1, 1940. 5 at $1,000. Nos. A1036–A1040	$5,000.00	
2 Georgia Railway & Electric Co. first consolidated mortgage, 5's, sinking fund, gold, due Jan. 1, 1932. 2 at $1,000. Nos. 1061, 1600	2,060.00	
13 Government of the Province of Alberta bonds, 4.5 per cent, 10-year gold debenture, due Dec. 1, 1923. 2 at $500 and 11 at $100. Nos. 2031 and 2032, 1501–1511	2,021.25	
6 Government of the Province of Alberta bonds, 5 per cent, 10-year gold debenture, due May 1, 1925. 1 at $1,000 and 5 at $500. Nos. 2364, B189–B195.	3,395.00	
1 Government of the Province of Alberta bond, 4.5 per cent, 10-year gold debenture, due Feb. 1, 1924. 1 at $500. No. 2620	481.25	
6 Milwaukee Railway & Electric Light Co. general and refunding mortgage gold bond, series A, 5 per cent, due Dec. 1, 1951. 6 at $1,000. Nos. 2772, 5222, 5223, 5224, 3839, 3840	5,480.00	
6 Minneapolis General Electric Co. 5 per cent 30-year gold mortgage bonds, due Dec. 1, 1934. 6 at $1,000. Nos. 1621, 1622, 1949, 2004, 7579, 7580	6,080.00	
4 Niagara Falls Power Co. first mortgage, 5's, gold coupon bonds, due Jan. 1, 1932. 4 at $1,000. Nos. 5246, 5247, 6583, 8358	4,100.00	
20 Riggs Realty Co. 3/30-year coupon bond, first, 5's, due Oct. 1, 1940. 20 at $1,000. Nos. 56, 60, 76, 80, etc., to 144	20,705.00	
9 Southern Bell Telephone & Telegraph Co. 30-year, first mortgage, 5's, sinking fund, gold bonds. Due Jan. 1, 1941. 9 at $1,000. Nos. M9739 M11576, M11577, M11578, M11579, M13965, M15568, M15569, M15570	8,817.50	
1 Union Electric Light & Power Co. of St. Louis, first, 5's, due Sept. 1, 1932. 1 at $1,000. No. 4169.	1,010.00	
		$122,321.85
3. Bank balance, Dec. 31, 1915 [1]		15,147.15
		243,219.00

LIABILITIES.

	Income.	Capital.
General fund:		
Invested	$4,700.00	.....
Uninvested	2,139.95	.....
Agassiz fund:		
Invested		$49,900.00
Uninvested		100.00
Bache fund:		
Invested	2,575.00	55,917.95
Uninvested	3,832.57	82.05

[1] Two outstanding checks, $63.13.

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	Income.	Capital.
Building fund:		
Invested	$1,562.50	$5,490.00
Uninvested	391.53	1,510.00
Comstock fund:		
Invested	677.50	11,315.00
Uninvested	708.82	22.50
Draper fund:		
Invested	1,035.00	10,000.00
Uninvested	1,247.06	.....
Gibbs fund:		
Invested	.....	5,457.50
Uninvested	345.77	42.50
Gould fund:		
Invested	4,057.50	19,953.75
Uninvested	859.65	46.25
Marsh fund:		
Invested	677.50	9,377.65
Uninvested	271.88	750.00
Murray fund:		
Invested	.....	5,965.00
Uninvested	.....	35.00
Smith fund:		
Invested	1,532.50	9,895.00
Uninvested	762.27	105.00
Watson fund:		
Invested	1,020.00	24,922.50
Uninvested	92.65	77.50
Marcellus Hartley fund:		
Invested	.....	1,020.00
Uninvested	147.50	148.00
William Ellery Hale lectureship:		
Invested	.....	.....
Uninvested	300.00	.....
Proceedings:		
Invested	1,020.00	.....
Uninvested	1,128.70	.....
Total	31,085.85	212,133.15
		31,085.85
		243,219.00

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ACCOUNT WITH INDIVIDUAL FUNDS JAN. 1 TO DEC. 31, 1915.

	General fund.		Building fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1915:				
Cash	$1,416.65		$437.53	$10.00
Invested	5,200.00		1,077.50	6,990.00
Receipts:				
Interest on investments	2,759.18		441.99	
Interest on deposits	211.80			
Murray fund return	300.00			
Annual dues—				
1913	5.00			
1914	30.00			
Hale lectureship return	495.62			
Total	10,418.25		1,957.02	7,000.00
Disbursements:				
General expenses	3,482.68			
Hale lectureship refund	95.62			
Accrued interest			2.99	
Balance Dec. 31, 1915:				
Cash	2,139.95		391.53	1,510.00
Invested	4,700.00		1,562.50	5,490.00
Total	10,418.25		1,957.02	7,000.00
Mortgage paid	500.00			1,500.00
Investment made			485.00	

	Agassiz fund.		Bache fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1915:				
Cash		$100.00	$2,552.81	$67.05
Invested		49,900.00	2,575.00	55,932.95
Receipts:				
Interest on investments			3,057.43	
Return estate of B. O. Peirce			325.03	
Total		50,000.00	8,510.27	56,000.00
Disbursements:				
Warrants			2,090.96	
General expenses			8.75	
Accrued interest			2.99	
Balance Dec. 31, 1915:				
Cash		100.00	3,832.57	82.05
Invested		49,900.00	2,575.00	55,917.95
Total		50,000.00	8,510.27	56,000.00
Mortgage paid				500.00
Investment made				485.00

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Account with individual funds Jan. 1 to Dec. 31, 1915—Continued.

	Comstock fund.		Draper fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1915:				
Cash	$620.81	$22.50	$1,018.33	.....
Invested	192.50	11,315.00	2,035.00	$10,000.00
Receipts:				
Interest on investments	576.00	.....	593.33	.....
Total	1,389.31	11,337.50	3,646.66	10,000.00
Disbursements:				
Warrants	.....	.....	1,150.00	.....
Medal	.....	.....	214.60	.....
Accrued interest	2.99	.....	.....	.....
Balance Dec. 31, 1915:				
Cash	708.82	22.50	1,247.06	.....
Invested	677.50	11,315.00	1,035.00	10,000.00
Total	1,389.31	11,337.50	3,646.66	10,000.00
Mortgage paid	.....	.....	1,000.00	.....
Investment made	485.00	.....	.....	.....

	Gibbs fund.		Gould fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1915:				
Cash	$164.49	$27.50	$1,062.14	$18.75
Invested	.....	5,472.50	4,057.50	19,981.25
Receipts:				
Interest on investments	284.27	.....	1,186.11	.....
Total	448.76	5,500.00	6,305.75	20,000.00
Disbursements:				
Warrants	100.00	.....	1,300.00	.....
Accrued interest	2.99	.....	88.60	.....
Balance Dec. 31, 1915:				
Cash	345.77	42.50	859.65	46.25
Invested	.....	5,457.50	4,057.50	19,953.75
Total	448.76	5,500.00	6,305.75	20,000.00
Mortgages paid	.....	500.00	.....	5,000.00
Investments made	.....	485.00	.....	4,972.50

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Account with individual funds Jan. 1 to Dec. 31, 1915—Continued.

	Marsh fund.		Murray fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1915:				
Cash	$425.87			$35.00
Invested	192.50	$9,377.65		5,965.00
Receipts:				
Interest on investments	334.00		$300.00	
Estate of O. C. Marsh		750.00		
Total	952.37	10,127.65	300.00	6,000.00
Disbursements:				
Return to general fund			300.00	
Accrued interest	2.99			
Balance Dec. 31, 1915:				
Cash	271.88	750.00		35.00
Invested	677.50	9,377.65		5,965.00
Total	952.37	10,127.65	300.00	6,000.00
Investment made	485.00			

	Smith fund.		Watson fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1915:				
Cash	$696.58	$15.00	$81.15	$77.50
Invested	1,532.50	9,985.00	1,020.00	24,922.50
Receipts:				
Interest on investments	572.50		1,271.50	
Total	2,801.58	10,000.00	2,372.65	25,000.00
Disbursements:				
Warrants	500.00		1,260.00	
Accrued interest	6.81			
Balance Dec. 31, 1915:				
Cash	762.27	105.00	92.65	77.50
Invested	1,532.50	9,895.00	1,020.00	24,922.50
Total	2,801.58	10,000.00	2,372.65	25,000.00
Bond paid		1,000.00		
Investment made		910.00		

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Account with individual funds Jan. 1 to Dec. 31, 1915—Continued.

	Proceedings.		Hale lectureship.	
	Income.	Capital.	Income.	Capital.
Balance, Jan. 1, 1915:				
Cash	$1,828.84			
Invested	1,020.00			
Receipts:				
Interest on investments	50.00			
Contribution to Hale lectureship			$1,000.00	
Reprints and separate numbers	376.81			
Contribution to Proceedings	1,990.00			
Subscriptions, 1915	494.22			
Subscriptions, 1916	44.50			
Annual dues, 1915	645.00			
Hale lectureship refund			95.62	
Total	6,449.37		1,095.62	
Disbursements:				
General expenses	4,300.67			
Return to General fund			495.62	
Honorariums			300.00	
Balance, Dec. 31, 1915:				
Cash	1,128.70		300.00	
Invested	1,020.00			
Total	6,449.37		1,095.62	

	Hartley fund.	
	Income.	Capital.
Balance, Jan. 1, 1915:		
Cash	$22.50	$580.00
Invested		1,020.00
Receipts:		
Interest on investments	50.00	
Contribution to public welfare medal	75.00	
Total	147.50	1,600.00
Disbursements:		
General expenses		432.00
Balance, Dec. 31, 1915:		
Cash	147.50	148.00
Invested		1,020.00
Total	147.50	1,600.00

WHITMAN CROSS,
Treasurer.

JANUARY 5, 1916.

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REPORT OF THE AUDITING COMMITTEE.

WASHINGTON, D. C., *January 14, 1916.*

We hereby certify that we have examined the securities and papers contained in the box of the National Academy of Sciences at the American Security & Trust Co.'s building and have found them to correspond with the list checked by the auditing committee on January 15, 1915.

We find that the coupons due in 1915 have been cut and are accounted for; also that the coupons due January 1, 1916, have been detached and are accounted for by an appropriate entry in the pass book. We have accepted the certified statement of the Capital Audit Co. as to the correspondence between the vouchers, pass book, and accounts of the treasurer and as to the balance shown by the books of the treasurer on December 31, 1915, and certify to its agreement with the balance shown by the report of the treasurer, by his check book and by the American Security & Trust Co.

W. H. DALL.
F. W. CLARKE.

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APPENDICES.

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APPENDIX A.

CONSTITUTION OF THE NATIONAL ACADEMY.

As amended and adopted April 17, 1872, and further amended April 20, 1875; April 21, 1881; April 19, 1882; April 18, 1883; April 19, 1888; April 18, 1895; April 20, 1899; April 17, 1902; April 18, 1906; November 20, 1906; April 17, 1907; November 20, 1907; April 20, 1911; April 16, 1912; April 21, 1915.

PREAMBLE.

Empowered by the act of incorporation enacted by Congress, and approved by the President of the United States on the 3d day of March, A. D. 1863, and in conformity with amendments to said act approved July 14, 1870, June 20, 1884, and May 27, 1914, the National Academy of Sciences adopts the following amended constitution and rules:

ARTICLE I.—OF MEMBERS.

SECTION 1. The academy shall consist of members, honorary members, and foreign associates. Members must be citizens of the United States.

SEC. 2. Members who, from age or inability to attend the meetings of the academy, wish to resign the duties of active membership, may, at their own request, be transferred to the roll of honorary members by a vote of the academy.

SEC. 3. The academy may elect 50 foreign associates.

SEC. 4. Honorary members and foreign associates shall have the privilege of attending the meetings and of reading and communicating papers to the academy, but shall take no part in its business, shall not be subject to its assessments, and shall be entitled to a copy of the publications of the academy.

ARTICLE II.—OF THE OFFICERS.

SECTION 1. The officers of the academy shall be a president, a vice president, a foreign secretary, a home secretary, and a treasurer, all of whom shall be elected for a term of six years, by a majority of votes present, at the first stated meeting after the expiration of the current terms, provided that existing officers retain their places until their successors are elected. In case of a vacancy, the election for six years shall be held in the same manner at the meeting when such vacancy occurs, or at the next stated meeting thereafter, as the academy may direct. A vacancy in the office of treasurer or home

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secretary may, however, be filled by appointment of the president of the academy until the next stated meeting of the academy.

SEC. 2. The officers of the academy, together with six members to be elected by the academy, shall constitute a council for the transaction of such business as may be assigned to them by the constitution or the academy.

SEC. 3. The president of the academy, or, in case of his absence or inability to act, the vice president, shall preside at the meetings of the academy and of the council; shall name all committees except such as are otherwise especially provided for; shall refer investigations required by the Government of the United States to members especially conversant with the subjects and report thereon to the academy at its meeting next ensuing; and, with the council, shall direct the general business of the academy.

It shall be competent for the president, in special cases, to call in the aid, upon committees, of experts or men of special attainments not members of the academy.

The president shall be, *ex officio*, a member of all committees empowered to consider questions referred to the academy by the Government of the United States.

SEC. 4. The foreign and home secretaries shall conduct the correspondence proper to their respective departments, advising with the president and council in cases of doubt, and reporting their action to the academy at one of the stated meetings in each year.

It shall be the duty of the home secretary to give notice to the members of the place and time of all meetings, of all nominations for membership, and of all proposed amendments to the constitution.

It shall be the duty of the home secretary to keep the minutes of each business and scientific session, and after approval to enter these upon the permanent records of the academy.

SEC. 5. The treasurer shall attend to all receipts and disbursements of the academy, giving such bond and furnishing such vouchers as the council may require. He shall collect all dues, assessments, and subscriptions, and keep a set of books showing a full account of receipts and disbursements and the condition of all funds of the academy. He shall be the custodian of the corporate seal of the academy.

ARTICLE III.—OF THE MEETINGS.

SECTION 1. The academy shall hold one stated meeting in each year, called the annual meeting, in the city of Washington, beginning on the third Monday in April, and another, called the autumn meeting, to be held at such place and time as the council shall determine.

Special business meetings of the academy may be called, by order of eight members of the council, at such place and time as may be designated in the call.

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Special scientific meetings of the academy may be held at times and places to be designated by a majority of the council.

SEC. 2. The names of the members present at each session of a meeting shall be recorded in the minutes, and the members present at any session shall constitute a quorum for the transaction of business.

SEC. 3. Scientific sessions of the academy, unless otherwise ordered by a majority of the members present, shall be open to the public; sessions for the transaction of business shall be closed.

SEC. 4. Stated meetings of the council shall be held during the stated or special meetings of the academy and four members shall constitute a quorum for the transaction of business. Special meetings of the council may be convened at the call of the president and two members of the council, or of four members of the council.

SEC. 5. No member whose dues are in arrears shall vote at any business meeting of the academy.

ARTICLE IV.—OF ELECTIONS AND RESIGNATIONS.

SECTION 1. All elections of officers and members shall be by ballot, and each election shall be held separately.

SEC. 2. The time for holding an election of officers shall be fixed by the academy at least one day before the election is held.

SEC. 3. The election of the six members of the council shall be as follows:

At the annual meeting in April, 1907, six members of the council to be elected, of whom two shall serve for three years, two for two years, and two for one year, their respective terms to be determined by lot. Each year thereafter the terms of two members shall expire, and their successors, to serve for three years, shall be elected at the annual meeting in each year.

SEC. 4. The academy shall be divided by the council into sections representing the principal branches of scientific research. Each section shall elect its own chairman, who shall serve for three years. The chairman shall be responsible to the academy for the work of his section.

Nominations to membership in the academy shall be made in writing and approved by a majority of the members of the section on the branch of research in which the person nominated is eminent, or by a majority of the council in case there is no section on the subject. The nominations shall be sent to the home secretary by the chairman of the section before January 1 of the year in which the election is to be held, and each nomination shall be accompanied by a list of the principal contributions of the nominee to science. This list shall be printed by the home secretary for distribution among the members of the academy.

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SEC. 5. Election of members shall be held at the annual meeting in Washington in the following manner: There shall be two ballots—a preference ballot, which may be prepared either before or at the annual meeting and must be transmitted to the home secretary, and a final ballot, to be taken at the meeting.

Preference ballot.—Each member may inscribe on a ballot not more than 15 names of nominees selected from the submitted list. A list of the nominees shall then be prepared, on which the names shall be entered in the order of the number of votes received by each. In case two or more nominees have the same number of votes on this preference list, the order in which they shall be placed on the list shall be determined by a majority vote of members present.

Final ballot.—A vote shall first be taken on the nominee who appears first on the preference list, and he shall be declared elected if he receive two-thirds of the votes cast and not less than 25 votes in all. A vote shall then be taken in similar manner on the nominee standing second on the preference list, and so on until all the nominees on the preference list shall have been acted on, or until 15 nominees shall have been elected or until the total membership of the academy shall have reached 250.

Not more than 15 members shall be elected at one annual meeting.

Before and during elections a discussion of the merits of nominees will be in order.

The election of members may be suspended at any time by a majority vote of the members present.

SEC. 6. Every member-elect shall accept his membership, personally or in writing, before the close of the next stated meeting after the date of his election. Otherwise, on proof that the secretary has formally notified him of his election, his name shall not be entered on the roll of members.

SEC. 7. Foreign associates may be nominated by the council and may be elected at the annual meeting by a two-thirds vote of the members present.

SEC. 8. A diploma, with the corporate seal of the academy and the signatures of the officers, shall be sent by the appropriate secretary to each member on his acceptance of membership, and to foreign associates on their election.

SEC. 9. Resignations shall be addressed to the president and acted on by the academy.

SEC. 10. Whenever a member has not paid his dues for four successive years, the treasurer shall report the fact to the council, which may report the case to the academy with the recommendation that the person thus in arrears be declared to have forfeited his membership. If this recommendation be approved by two-thirds of the members present, the said person shall no longer be a member of the academy and his name shall be dropped from the roll.

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ARTICLE V.—SCIENTIFIC COMMUNICATIONS, PUBLICATIONS, AND REPORTS.

SECTION 1. Communications on scientific subjects shall be read at scientific sessions of the academy, and papers by any member may be read by the author or by any other member, notice of the same having been previously given to the secretary.

SEC. 2. Any member of the academy may read a paper from a person who is not a member, and shall not be considered responsible for the facts or opinions expressed by the author, but shall be held responsible for the propriety of the paper.

Persons who are not members may read papers on invitation of the council or of the committee of arrangements.

SEC. 3. The academy may provide for the publication, under the direction of the council, of proceedings, scientific memoirs, biographical memoirs, and reports.

The proceedings shall include the transactions of the academy, brief original announcements of the results of scientific investigations made by members of the academy or others, together with short original articles giving a comprehensive survey of the more important scientific researches currently made by American investigators, and other matters of general scientific interest.

The scientific memoirs shall provide opportunity for the publication of longer and more detailed scientific investigations.

The biographical memoirs shall contain an appropriate record of the life and work of deceased members of the academy.

An annual report shall be presented to Congress by the president, and shall contain the annual reports of the treasurer and the auditing committee, a suitable summary of the reports of the committees in charge of trust funds, and a record of the activities of the academy for the calendar year immediately preceding and other appropriate matter. This report shall be presented to Congress by the president after authorization by the council. It shall also be presented to the academy at the annual meeting next following.

The treasurer shall prepare a full report of the financial affairs of the academy at the end of the fiscal year. This report shall be submitted to the council for approval and afterwards presented to the academy at the annual meeting.

SEC. 4. Propositions for investigations or reports by the academy shall be submitted to the council for approval, except those requested by the Government of the United States, which shall be acted on by the president, who will in such cases report their results to the Government as soon as obtained and to the academy at its next following stated meeting.

SEC. 5. The advice of the academy shall be at all times at the disposition of the Government upon any matter of science or art within its scope.

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ARTICLE VI.—OF THE PROPERTY OF THE ACADEMY.

SECTION 1. All investments and reinvestments of either principal or accumulations of income of the trust and other funds of the academy shall be made by the treasurer, with the approval of the finance committee, in the corporate name of the academy, in the manner and in the securities designated or specified in the instruments creating the several funds, or, in the absence of such designation or specification, in bonds of the United States or of the several States, or in bonds or notes secured by first mortgages on real estate, in investments legal for savings banks under the laws of Massachusetts or New York, or in other bonds recommended to the treasurer by the fiscal advisers of the academy.

The treasurer may invest the capital of all trust funds of the academy which are not required by the instruments creating such funds to be kept separate and distinct, in a consolidated fund, and shall apportion the income received from such consolidated fund among the various funds composing the same in the proportion that each of said funds shall bear to the total amount of funds so invested; provided, however, that the treasurer shall at all times keep accurate accounts showing the amount of each trust fund, the proportion of the income from the consolidated fund to which it is entitled, and the expenses and disbursements properly chargeable to such fund.

SEC. 2. The council shall at its annual meeting in each year designate one bank or trust company in Washington, D. C., and one in New York City, to act, when requested by the treasurer, as the fiscal advisers of the academy.

SEC. 3. The treasurer shall have authority, with the approval of the finance committee, to sell, transfer, convey, and deliver in the corporate name and for the benefit of the academy any stocks, bonds, or other securities standing in the corporate name.

SEC. 4. No contract shall be binding upon the academy which has not been first approved by the council.

SEC. 5. The assessments required for the support of the academy shall be fixed by the academy on the recommendation of the council and shall be payable within the calendar year for which they are assessed.

ARTICLE VII.—OF TRUST FUNDS AND THEIR ADMINISTRATION.

SECTION 1. Devises, bequests, donations, or gifts having for their object the promotion of science or the welfare of the academy may be accepted by the council for the academy. Before the acceptance of any such trust the council shall consider the object of the trust and all conditions or specifications attaching thereto. The council shall make a report of its action to the academy.

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SEC. 2. Medals and prizes may be established in accordance with the provisions of trusts or by action of the academy.

SEC. 3. Unless otherwise provided by the deed of gift, the income of each trust fund shall be applied to the objects of that trust by the action of the academy on the recommendation of a standing committee on that fund.

ARTICLE VIII.—OF ADDITIONS AND AMENDMENTS.

Additions and amendments to the constitution shall be made only at a stated meeting of the academy. Notice of a proposition for such a change must be submitted to the council, which may amend the proposition, and shall report thereon to the academy. Its report shall be considered by the academy in committee of the whole for amendment.

The proposition as amended, if adopted in committee of the whole, shall be voted on at the next stated meeting, and if it receives two-thirds of the votes cast it shall be declared adopted.

Absent members may send their votes on pending changes in the constitution to the home secretary in writing, and such votes shall be counted as if the members were present.

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APPENDIX B.

RULES.

(In accordance with a resolution of the academy, taken at its meeting on April 21, 1915, the rules are arranged in groups and each group is numbered to correspond with the article of the constitution to which it relates.)

I.

1. The holders of the medal for eminence in the application of science to the public welfare shall be notified, like members, of the meetings of the academy, and invited to participate in its scientific sessions.

II.

1. The proper secretary shall acknowledge all donations made to the academy, and shall at once report them to the council for its consideration.

2. The home secretary shall be the custodian of all books, apparatus, archives, and collections not explicitly assigned to other care.

3. The home secretary shall keep a record of all grants of money or awards of prizes or medals made from trust funds of the academy. The record for each grant of money shall include the following items:

1. Name of fund.
2. Date and number of the grant.
3. Name and address of recipient.
4. Amount of grant and date or dates of payment.
5. Purpose of grant.
6. Record or report of progress.
7. Resulting publications.

4. The treasurer shall keep the home secretary informed of all warrants received from directors of trust funds not controlled by the academy and of the date or dates of payment of all warrants.

5. The treasurer is authorized to defray, when approved by the president, all the proper expenses of committees appointed to make scientific investigations at the request of departments of the Government, and in each case to look to the department requesting the investigation for reimbursement to the academy.

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III.

1. At the business sessions of the academy the order of procedure shall be as follows:

1. Chair taken by the president, or, in his absence, by the vice president.
2. Roll of members called by home secretary (first session of the meeting only).
3. Minutes of the preceding session read and approved.
4. Stated business.
5. Reports of president, secretaries, treasurer, and committees.
6. Business from council.
7. Other business.

2. The rules of order of the academy shall be those of the Senate of the United States, unless otherwise provided by the constitution or rules of the academy.

3. In the absence of any officer a member shall be chosen to perform his duties temporarily, by a plurality of *viva voce* votes, upon open nomination.

4. At each meeting the president shall announce the death of any members since the preceding meeting. As soon as practicable thereafter he shall designate a member to write—or to secure from some other source approved by the president—a biographical notice of each deceased member.

5. A standing committee of three members called the program committee, a local committee of five members appointed for each meeting, and the home secretary shall together constitute the committee of arrangements, of which the home secretary shall be chairman.

The term of service on the program committee shall be three years, one member retiring annually, the chairman to be designated by the president.

It shall be the duty of the program committee to prepare the scientific program for the annual meeting, and for this purpose it shall be empowered to solicit papers from members or others. It shall also be empowered to ascertain the length of time required for reading papers to be presented at the scientific sessions of the academy, and, when it appears advisable, to limit the time to be occupied in their presentation or discussion.

The local committee shall meet not less than two months previous to each meeting. It shall prepare the detailed program of each day, and in general shall have charge of all business and scientific arrangements for the meeting for which it is appointed except those specifically assigned to the program committee in the case of the annual meeting.

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IV.

1. The term of service of each chairman of a section shall be three years, to date from the closing session of the April meeting next following his election. Chairmen of sections shall be chosen by mail ballot, the member receiving the highest number of votes cast to be deemed elected. It shall be the duty of each retiring chairman to conduct the election of his successor and to report the result of the election to the home secretary before the April meeting at which his term of service expires. Should any section fail to elect a chairman before November 1, the president is empowered to appoint a temporary chairman to serve until the April meeting next following. No chairman shall be eligible for reelection for two consecutive terms.

2. The chairman of each section of the academy shall submit to the members of his section, not later than November 1 of each year, a ballot containing the names of all those persons who received not less than two votes in the nominating ballot of the preceding year and of any other persons who were newly proposed for consideration at that time. Each member of the section shall be expected to return this ballot to the chairman within two weeks with his signature and with crosses placed against the names of those persons whom he is prepared to endorse for nomination. Each member may also write upon the ballot in a place provided for the purpose any new names which he desires to have included in the ballot to be submitted to the section in the following year. The vote resulting from this ballot shall be regarded as informal.

The chairman shall then submit to the members of his section a new ballot showing the results of the informal vote; and each member shall be expected to return this ballot to the chairman with his signature and with crosses placed against the names of those persons whom he will endorse for nomination.

The chairman shall then certify to the home secretary, prior to January 1, the names of those persons who have been voted for on this second ballot by a majority of the members of the section, and shall furnish him a list of the publications of these nominees, as required by the constitution.

3. Nominations for membership shall give the full name, residence, and the official positions successively held by the candidate, in addition to the list of his contributions to science required by the constitution.

4. Preference ballots for election of members shall be sealed in a blank envelope, which shall be inclosed in another bearing the name of the sender, and which shall be addressed to the home secretary. Such envelopes shall be opened only by the tellers. If in any case the

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tellers are unable to determine who cast a ballot, or if the latter contains more names than are to be voted for, the ballot shall be rejected, but minor defects in a ballot shall be disregarded when the intent of the voter is obvious.

5. All discussions of the claims and qualifications of nominees at meetings of the academy shall be held strictly confidential, and remarks and criticisms then made may be communicated to no person who was not a member of the academy at the time of the discussion.

V.

1. The publication of the Proceedings shall be under the general charge of the council, which shall have final jurisdiction upon all questions of policy relating thereto. The preparation of the Proceedings for publication shall be entrusted to an editorial board. This board shall consist of a chairman and a managing editor, both of whom shall be appointed by the council for definite terms of service; of the home secretary and foreign secretary *ex officiis*, and of a body of associate editors representing the various branches of science which are to be included in the scope of the proceedings. The managing editor, who may be a non-member of the academy, shall receive a salary, which shall be fixed by the council. It shall be the duty of the managing editor to prepare the proceedings in detail for publication; but the chairman of the editorial board shall decide, in consultation with the managing editor, in regard to the acceptance, rejection, or substantial modification of papers offered for publication. The associate editors shall be appointed by the council, upon recommendation of the chairman of the editorial board, for a period of three years, one-third of them retiring annually. The home secretary and the foreign secretary shall be responsible for the distribution of the proceedings in their respective fields.

2. Memoirs may be presented at any time to the home secretary, who shall report the date of their reception at the next session; but no memoir shall be published unless it has been read or presented by title before the academy.

Before publication all biographical and scientific memoirs must be referred to the committee on publication, who may, if they deem best, refer any memoir to a special committee appointed by the president to determine whether the same should be published by the academy.

3. Memoirs shall date, in the records of the academy, from the date of their presentation to the academy, and the order of their presentation shall be so arranged by the secretary that, so far as may be convenient, those upon kindred topics shall follow one another.

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4. The annual report of the treasurer shall contain:

1. A concise statement of the source, object, and amount of all trust funds of the academy.

2. A condensed statement of receipts and expenditures.

3. A statement of assets and liabilities.

4. Accounts with individual funds.

5. Such other matter as he considers appropriate.

5. The accounts of the treasurer shall, between January 1 and January 15 of each year, be audited by a committee of three members to be appointed by the president at the autumn meeting of the academy. It shall be the duty of the auditing committee to verify the record of receipts and disbursements maintained by the treasurer and the agreement of book and bank balances; to examine all securities in the custody of the treasurer and to compare the stated income of such securities with the receipts of record; to examine all vouchers covering disbursements for account of the academy and the authority therefor and to compare them with the treasurer's record of expenditures; to examine and verify the account of the academy with each trust fund. The auditing committee may employ an expert accountant to assist the committee in the examination of the books of the treasurer. The annual report of the treasurer shall be published with that of the president to Congress. The reports of the treasurer and auditing committee shall be presented to the academy at the annual meeting.

VI.

1. All apparatus and other materials of permanent value purchased with money from any grant from a trust fund shall be the property of the academy unless specific exception is made in the grant or by subsequent action of the council or the directors of the trust fund concerned. Receipts for all such property shall be signed by the grantee and shall be forwarded to the home secretary. All apparatus and unused material of value acquired in this way shall be delivered to the home secretary on completion of the investigation for which the grant was made, or at any time on demand of the council, and the home secretary shall give an appropriate release therefor.

2. The books, apparatus, archives, and other collections of the academy shall be deposited in some safe place in the city of Washington. A list of the articles so deposited shall be kept by the home secretary, who is authorized to employ a clerk to take charge of them.

3. A stamp corresponding to the corporate seal of the academy shall be kept by the secretaries, who shall be responsible for the due marking of all books and other objects to which it is applicable.

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Labels or other proper marks of similar device shall be placed upon objects not admitting of the stamp.

4. The fiscal year of the academy shall end on December 31 of each year.

5. The standing committee on finance shall consist of the treasurer *ex officio* as chairman and two members to be appointed annually by the president.

VII.

1. Standing committees of the academy on trust funds the income of which is applied to the promotion of research shall consist of three or five members. In order to secure rotation in office in such committees, when not in conflict with the provisions of the deeds of gift, the term of service on a committee of three members shall be three years; on a committee of five members the term shall be five years.

2. The annual reports of the committees on research funds shall, so far as the academy has authority to determine their form, give a current number to each award, stating the name, position, and address of the recipient, the subject of research for which the award is made, and the sum awarded; and in later annual reports the status of the work accomplished under each award previously made shall be announced, until the research is completed, when announcement of its completion and, if published, the title and place of publication shall be stated, and the record of the award shall be reported as closed.

VIII.

1. Any rule of the academy may be amended, suspended, or repealed on the written motion of any two members, signed by them, and presented at a stated meeting of the academy, provided the same shall be approved by a majority of the members present.

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APPENDIX C.

ORGANIZATION OF THE ACADEMY, 1915–16.

	Expiration of term.
WELCH, WILLIAM H., *President*	April, 1919
WALCOTT, CHARLES D., *Vice President*	April, 1919
HALE, GEORGE E., *Foreign Secretary*	April, 1916
DAY, ARTHUR L., *Home Secretary*	April, 1919
CROSS, WHITMAN, *Treasurer*	April, 1917

ADDITIONAL MEMBERS OF COUNCIL.

1913–1916.

CHITTENDEN, R. H. — WILSON, EDMUND B.

1914–1917.

CONKLIN, E. G. — NOYES, A. A.

1915–1918.

COULTER, J. M. — HOWELL, W. H.

SECTIONS.

1. MATHEMATICS.

BÔCHER, MAXIME
BOLZA, OSKAR
DICKSON, L. E.
MOORE, E. H. (*Acting Chairman*)
MOULTON, F. R.
OSGOOD, W. F.
STORY, W. E.
VAN VLECK, E. B.
WEBSTER, A. G.
WHITE, H. S.
WOODWARD, R. S.

2. ASTRONOMY.

ABBOT, C. G.
BARNARD, E. E.
CAMPBELL, W. W.
COMSTOCK, G. C. (*Acting Chairman*)
ELKIN, W. L.
FROST, E. B.
HALE, G. E.
LEUSCHNER, A. O.
MOULTON, F. R.
PICKERING, E. C.
WOODWARD, R. S.

3. PHYSICS AND ENGINEERING.

ABBE, CLEVELAND
ABBOT, H. L.
AMES, J. S.
BARUS, CARL
BELL, A. G.
BUMSTEAD, H. A.
CREW, HENRY
HALL, E. H.
HASTINGS, C. S.
HAYFORD, J. F.
MENDENHALL, T. C.
MERRITT, ERNEST
MICHELSON, A. A.
MILLIKAN, R. A.
MORLEY, E. W.
NICHOLS, E. F.
NICHOLS, E. L.
PICKERING, E. C.
PUPIN, M. I.
ROSA, E. B.
THOMSON, ELIHU
TROWBRIDGE, JOHN
WEBSTER, A. G.
WOOD, R. W.
WOODWARD, R. S. (*Acting Chairman*)

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4. CHEMISTRY.

Boltwood, B. B.
Chandler, C. F.
Chittenden, R. H.
Clarke, F. W.
Crafts, J. M.
Franklin, E. C.
Gomberg, Moses
Gooch, F. A.
Hilgard, E. W.[1]
Hillebrand, W. F.
Jackson, C. L.
Lewis, G. N.
Michael, Arthur
Morley, E. W.
Morse, H. N.
Noyes, A. A. (*Acting Chairman*)
Noyes, W. A.
Osborne, T. B.
Remsen, Ira
Richards, T. W.
Smith, Alexander
Smith, Edgar F.
Stieglitz, J. O.
Wells, H. L.

5. GEOLOGY AND PALEONTOLOGY.

Becker, G. F.
Branner, J. C.
Chamberlin, T. C.
Clark, W. B.
Clarke, J. M.
Cross, Whitman
Dall, W. H.
Dana, E. S.
Davis, W. M.
Day, A. L.
Gilbert, G. K.
Hague, Arnold (*Acting Chairman*)
Iddings, J. P.
Kemp, J. F.
Lindgren, Waldemar
Osborn, H. F.
Pirsson, L. V.
Pumpelly, Raphael
Ransome, F. L.
Reid, H. F.
Schuchert, Charles
Scott, W. B.
Van Hise, C. R.
Walcott, C. D.
White, David
Williston, S. W.

6. BOTANY.

Britton, N. L.
Campbell, D. H.
Coulter, J. M. (*Chairman, 1915–1918*)
Farlow, W. G.
Goodale, G. L.
Harper, R. A.
Sargent, C. S.
Smith, Erwin F.
Thaxter, Roland
Trelease, William

7. ZOOLOGY AND ANIMAL MORPHOLOGY.

Allen, J. A.
Castle, W. E.
Conklin, E. G. (*Acting Chairman*)
Dall, W. H.
Davenport, C. B.
Donaldson, H. H.
Harrison, R. G.
Jennings, H. S.
Lillie, F. R.
Mall, F. P.
Mark, E. L.
Merriam, C. H.
Morgan, T. H.
Morse, E. S.
Osborn, H. F.
Parker, G. H.
Verrill, A. E.
Walcott, C. D.
Wheeler, W. M.
Wilson, Edmund B.

8. PHYSIOLOGY AND PATHOLOGY.

Abel, J. J.
Benedict, F. G.
Cannon, W. B.
Chittenden, R. H. (*Acting Chairman*)
Councilman, W. T.
Flexner, Simon
Howell, W. H.
Loeb, Jacques
Lusk, Graham
Mall, F. P.
Meltzer, S. J.
Mendel, L. B.
Prudden, T. M.
Smith, Theobald
Vaughan, V. C.
Welch, W. H.
Wood, H. C.

9. ANTHROPOLOGY AND PSYCHOLOGY.

Boas, Franz
Cattell, J. McK.
Dewey, John
Fewkes, J. W.
Hall, G. S.
Holmes, W. H. (*Acting Chairman*)
Merriam, C. H.
Morse, E. S.
Royce, Josiah

[1] Died Jan. 8, 1916.

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STANDING COMMITTEES.

ON WEIGHTS, MEASURES, AND COINAGE.

MENDENHALL, T. C. (*Chairman*) MICHELSON, A. A. MORLEY, E. W.
WEBSTER, A. G. WOODWARD, R. S.

ON SOLAR RESEARCH.

HALE, G. E. (*Chairman*) CAMPBELL, W. W. MICHELSON, A. A.
NICHOLS, E. L. PICKERING, E. C.

ON PUBLICATION.

The PRESIDENT. The HOME SECRETARY. WALCOTT, C. D.

EDITORIAL BOARD OF THE PROCEEDINGS.

NOYES, A. A. (*Chairman*) WILSON, EDWIN B. (*Managing Editor*)
DAY, A. L. (*Home Secretary*) HALE, G. E. (*Foreign Secretary*)

ABEL, J. J., 1918.	COULTER, J. M., 1916.	HOLMES, W. H., 1917.
CANNON, W. B., 1916.	DAVENPORT, C. B., 1917.	IDDINGS, J. P., 1918.
CATTELL, J. McK., 1916.	FLEXNER, SIMON, 1916.	MILLIKAN, R. A., 1918.
CLARKE, J. M., 1918.	FROST, E. B., 1917.	MOORE, E. H., 1917.
CONKLIN, E. G., 1917.	HARRISON, R. G., 1916.	SMITH, ALEXANDER, 1918.

ON COLLECTION OF HISTORICAL PORTRAITS, MANUSCRIPTS, INSTRUMENTS, ETC.

WALCOTT, C. D. (*Chairman*) CLARKE, F. W. HAGUE, ARNOLD
HALE, G. E. MELTZER, S. J. PUPIN, M. I.

ON PROGRAM.

BOLTWOOD, B. B. (*Chairman*), 1918. CATTELL, J. McK., 1916.
FROST, E. B., 1917.

FINANCE COMMITTEE.

CROSS, WHITMAN (*Chairman*) HAGUE, ARNOLD WALCOTT, C. D.

TRUST FUNDS.

THE BACHE FUND.

[$56,000.]

Researches in physical and natural science.

FROST, E. B. (*Chairman*) HARRISON, R. G. WEBSTER, A. G.

THE WATSON FUND.

[$25,000.]

Watson Medal and the promotion of astronomical research.

PICKERING, E. C. (*Chairman*) ELKIN, W. L. FROST, E. B.

THE HENRY DRAPER FUND.

[$10,000.]

Draper Medal and investigations in astronomical physics.

HALE, G. E. (*Chairman*), 1918. AMES, J. S., 1920. CAMPBELL, W. W., 1919.
MICHELSON, A. A., 1917. TROWBRIDGE, JOHN, 1916.

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THE J. LAWRENCE SMITH FUND.

[$10,000.]

J. Lawrence Smith Medal and investigations of meteoric bodies.

MORLEY, E. W. (*Chairman*), 1919. DANA, E. S., 1918. HAGUE, ARNOLD, 1917.
PICKERING, E. C., 1920. REMSEN, IRA, 1916.

THE BARNARD MEDAL.[1]

Meritorious service to science.

WOODWARD, R. S. (*Chairman*) CAMPBELL, W. W. NICHOLS, E. F.
NOYES, A. A. RICHARDS, T. W.

THE BENJAMIN APTHORP GOULD FUND.

[$20,000.]

Researches in astronomy.

MOULTON, F. R. (*Chairman*) BARNARD, E. E. WOODWARD, R. S.

THE WOLCOTT GIBBS FUND.

[$5,500.]

Chemical research.

JACKSON, C. L. (*Chairman*) RICHARDS. T. W. SMITH, EDGAR F.

THE COMSTOCK FUND.

[$11,337.50.]

Researches in electricity, magnetism, and radiant energy.

NICHOLS, E. L. (*Chairman*), 1918. CREW, HENRY, 1916. NOYES, A. A., 1919.
THOMSON, ELIHU, 1920. WEBSTER, A. G., 1917.

THE MARSH FUND.

[$10,127.65.]

Original research in the natural sciences.

THE AGASSIZ FUND.

[$50,000.]

General uses of the Academy.

THE MURRAY FUND.

[$6,000.]

Agassiz Medal and contributions to oceanography.

HAGUE, ARNOLD (*Chairman*), 1916. DALL, W. H., 1918. PARKER, G. H., 1917.

THE MARCELLUS HARTLEY FUND.

[$1,200.]

Medal for eminence in the application of science to the public welfare.

BECKER, G. F. (*Chairman*)

HILLEBRAND, W. F. PUPIN, M. I. WEBSTER, A. G.
OSBORN, H. F. SMITH, THEOBALD WELCH, W. H.

[1] Every five years the committee recommends the person whom they consider most deserving of the medal, and upon the approval of the Academy the name of the nominee is forwarded to the trustees of Columbia University, who administer the Barnard Medal Fund.

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THE JOSEPH HENRY FUND.

To assist meritorious investigators, especially in the direction of original research.

The sum of $40,000 was contributed by Fairman Rogers, Joseph Patterson, George W. Childs, and others, as an expression of their respect and esteem for Prof. Joseph Henry. This amount was deposited with the Pennsylvania Company for the Insurance of Lives and Granting Annuities in Trust, with authorization to collect the income thereon and to pay over the same to Prof. Joseph Henry during his natural life, and after his death to his wife and daughters, and after the death of the last survivor to "deliver the said fund and the securities in which it shall then be invested to the National Academy of Sciences, to be thenceforward forever held in trust under the name and title of the 'Joseph Henry Fund.'"

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MEMBERS OF THE NATIONAL ACADEMY OF SCIENCES, DECEMBER 31, 1915.

		Date of election.
ABBE, CLEVELAND	*U. S. Weather Bureau, Washington, D. C.*	1879
ABBOT, CHARLES GREELEY	*Smithsonian Institution, Washington, D. C.*	1915
ABBOT, HENRY L., U. S. A.	*23 Berkeley St., Cambridge, Mass.*	1872
ABEL, JOHN JACOB	*Johns Hopkins University, Baltimore, Md.*	1912
ALLEN, J. ASAPH	*American Museum of Natural History, N. Y. City.*	1876
AMES, JOSEPH S	*Johns Hopkins University, Baltimore, Md.*	1909
BARNARD, E. E	*Yerkes Observatory, Williams Bay, Wis.*	1911
BARUS, CARL	*Brown University, Providence, R. I.*	1892
BECKER, GEORGE F	*U. S. Geological Survey, Washington, D. C.*	1901
BELL, A. GRAHAM	*1331 Connecticut Ave., Washington, D. C.*	1883
BENEDICT, FRANCIS GANO	*Nutrition Laboratory, Boston, Mass.*	1914
BOAS, FRANZ	*Columbia University, New York City.*	1900
BÔCHER, MAXIME	*Harvard University, Cambridge, Mass.*	1909
BOLTWOOD, B. B	*Yale University, New Haven, Conn.*	1911
BOLZA, OSKAR	*Reichsgrafenstr. 10, Freiburg, Germany.*	1909
BRANNER, JOHN C	*Stanford University, California.*	1905
BRITTON, NATHANIEL LORD	*New York Botanical Gardens, N. Y. City.*	1914
BUMSTEAD, HENRY ANDREWS	*Yale University, New Haven, Conn.*	1913
CAMPBELL, D. H	*Stanford University, California.*	1910
CAMPBELL, WILLIAM W	*Lick Observatory, Mount Hamilton, California.*	1902
CANNON, WALTER BRADFORD	*Harvard University, Cambridge, Mass.*	1914
CASTLE, WILLIAM ERNEST	*186 Payson Road, Belmont, Mass.*	1915
CATTELL, JAMES MCK	*Garrison, N. Y.*	1901
CHAMBERLIN, THOMAS C	*University of Chicago, Chicago, Ill.*	1903
CHANDLER, CHARLES F	*Columbia University, New York City.*	1874
CHITTENDEN, RUSSELL H	*Sheffield Scientific School, New Haven, Conn.*	1890
CLARK, W. B	*Johns Hopkins University, Baltimore, Md.*	1908
CLARKE, F. W	*U. S. Geological Survey, Washington, D. C.*	1909
CLARKE, J. M	*State Hall, Albany, N. Y.*	1909
COMSTOCK, GEORGE C	*Washburn Observatory, Madison, Wis.*	1899
CONKLIN, E. G	*Princeton, N. J.*	1908
COULTER, J. M	*University of Chicago, Chicago, Ill.*	1909
COUNCILMAN, WILLIAM T	*Harvard Medical School, Boston, Mass.*	1904
CRAFTS, JAMES M	*19 Commonwealth Ave., Boston, Mass.*	1872
CREW, HENRY	*Northwestern University, Evanston, Ill.*	1909
CROSS, WHITMAN	*U. S. Geological Survey, Washington, D. C.*	1908
DALL, WILLIAM H	*Smithsonian Institution, Washington, D. C.*	1897
DANA, EDWARD S	*Yale University, New Haven, Conn.*	1884
DAVENPORT, CHARLES B	*Cold Spring Harbor, N. Y.*	1912
DAVIS, WILLIAM MORRIS	*31 Hawthorn St., Cambridge, Mass.*	1904
DAY, ARTHUR L	*Geophysical Laboratory, Washington, D. C.*	1911
DEWEY, JOHN	*Columbia University, New York City.*	1910
DICKSON, LEONARD E	*University of Chicago, Chicago, Ill.*	1913
DONALDSON, HENRY HERBERT	*Wistar Institute of Anatomy, Phila., Pa.*	1914

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		Date of election.
ELKIN, WILLIAM L.	*Yale University Observatory, New Haven, Conn.*	1895
FARLOW, W. G.	*Harvard University, Cambridge, Mass.*	1879
FEWKES, JESSE WALTER	*Bureau of American Ethnology, Wash., D. C.*	1914
FLEXNER, SIMON	*Rockefeller Institute, New York City.*	1908
FRANKLIN, EDWARD CURTIS	*Stanford University, California.*	1914
FROST, EDWIN B.	*Yerkes Observatory, Williams Bay, Wis.*	1908
GILBERT, GROVE K.	*U. S. Geological Survey, Washington, D. C.*	1883
GOMBERG, MOSES	*University of Michigan, Ann Arbor, Mich.*	1914
GOOCH, FRANK A.	*Yale University, New Haven, Conn.*	1897
GOODALE, GEORGE L.	*Harvard University, Cambridge, Mass.*	1890
HAGUE, ARNOLD	*U. S. Geological Survey, Washington, D. C.*	1885
HALE, GEORGE E.	*Solar Observatory Office, Pasadena, Cal.*	1902
HALL, EDWIN H.	*Harvard University, Cambridge, Mass.*	1911
HALL, GRANVILLE STANLEY	*Clark University, Worcester, Mass.*	1915
HARPER, R. A.	*Columbia University, New York City.*	1911
HARRISON, ROSS G.	*Yale University, New Haven, Conn.*	1913
HASTINGS, CHARLES S.	*Yale University, New Haven, Conn.*	1889
HAYFORD, JOHN F.	*Northwestern University, Evanston, Ill.*	1911
HILGARD, EUGENE W.[1]	*University of California, Berkeley, Cal.*	1872
HILLEBRAND, WILLIAM F.	*Bureau of Standards, Washington, D. C.*	1908
HOLMES, WILLIAM H.	*U. S. National Museum, Washington, D. C.*	1905
HOWELL, WILLIAM H.	*Johns Hopkins University, Baltimore, Md.*	1905
IDDINGS, JOSEPH P.	*U. S. Geological Survey, Washington, D. C.*	1907
JACKSON, CHARLES L.	*6 Boylston Hall, Cambridge, Mass.*	1883
JENNINGS, HERBERT SPENCER	*Johns Hopkins University, Baltimore, Md.*	1914
KEMP, JAMES F.	*Columbia University, New York City.*	1911
LEUSCHNER, ARMIN O.	*University of California, Berkeley, Cal.*	1913
LEWIS, GILBERT N.	*University of California, Berkeley, Cal.*	1913
LILLIE, FRANK RATTRAY	*University of Chicago, Chicago, Ill.*	1915
LINDGREN, WALDEMAR	*Mass. Inst. of Technology, Boston, Mass.*	1909
LOEB, JACQUES	*Rockefeller Institute, New York City.*	1910
LUSK, GRAHAM	*Cornell University Medical College, New York City.*	1915
MALL, FRANKLIN P.	*Johns Hopkins University, Baltimore, Md.*	1907
MARK, EDWARD L.	*109 Irving St., Cambridge, Mass.*	1903
MELTZER, SAMUEL JAMES	*Rockefeller Institute, New York City.*	1912
MENDEL, LAFAYETTE B.	*18 Trumbull St., New Haven, Conn.*	1913
MENDENHALL, THOMAS C.	*329 North Chestnut St., Ravenna, Ohio.*	1887
MERRIAM, C. HART	*1919 16th St., Washington, D. C.*	1902
MERRITT, ERNEST	*Cornell University, Ithaca, N. Y.*	1914
MICHAEL, ARTHUR	*219 Parker St., Newton Center, Mass.*	1889
MICHELSON, ALBERT A.	*University of Chicago, Chicago, Ill.*	1888
MILLIKAN, ROBERT ANDREWS	*University of Chicago, Chicago, Ill.*	1915
MOORE, ELIAKIM H.	*University of Chicago, Chicago, Ill.*	1901
MORGAN, T. H.	*Columbia University, New York City.*	1909
MORLEY, EDWARD W.	*West Hartford, Conn.*	1897
MORSE, EDWARD S.	*Salem, Mass.*	1876
MORSE, HARMON N.	*Johns Hopkins University, Baltimore, Md.*	1907
MOULTON, F. R.	*University of Chicago, Chicago, Ill.*	1910
NICHOLS, EDWARD L.	*Cornell University, Ithaca, N. Y.*	1901
NICHOLS, ERNEST F.	*Dartmouth College, Hanover, N. H.*	1908

[1] Died Jan. 8, 1916.

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		Date of election.
Noyes, Arthur A.	*Massachusetts Institute of Technology, Boston, Mass.*	1905
Noyes, William A.	*University of Illinois, Urbana, Ill.*	1910
Osborn, H. F.	*American Museum of Natural History, New York City.*	1900
Osborne, T. B.	*Agricultural Experiment Station, New Haven, Conn.*	1910
Osgood, William Fogg.	*Harvard University, Cambridge, Mass.*	1904
Parker, George H.	*16 Berkeley St., Cambridge, Mass.*	1913
Pickering, Edward C.	*Harvard College Observatory, Cambridge, Mass.*	1873
Pirsson, Louis V.	*41 Trumbull St., New Haven, Conn.*	1913
Prudden, T. Mitchell.	*Columbia University, New York City.*	1901
Pumpelly, Raphael.	*Gibbs Ave., Newport, R. I.*	1872
Pupin, Michael I.	*Columbia University, New York City.*	1905
Ransome, Frederick Leslie.	*U. S. Geological Survey, Washington, D. C.*	1914
Reid, H. Fielding.	*Johns Hopkins University, Baltimore, Md.*	1912
Remsen, Ira.	*Johns Hopkins University, Baltimore, Md.*	1882
Richards, Theodore W.	*Wolcott Gibbs Mem. Lab., Cambridge, Mass.*	1899
Rosa, Edward B.	*Bureau of Standards, Washington, D. C.*	1913
Royce, Josiah.	*Harvard University, Cambridge, Mass.*	1906
Sargent, Charles S.	*Arnold Arboretum, Jamaica Plain, Mass.*	1895
Schuchert, Charles.	*Yale University, New Haven, Conn.*	1910
Scott, William B.	*Princeton University, Princeton, N. J.*	1906
Smith, Alexander.	*Columbia University, New York City.*	1915
Smith, Edgar F.	*University of Pennsylvania, Philadelphia, Pa.*	1899
Smith, Erwin F.	*Bureau of Plant Industry, Washington, D. C.*	1913
Smith, Theobald.	*Princeton, N. J.*	1908
Stieglitz, J. O.	*University of Chicago, Chicago, Ill.*	1911
Story, William E.	*Clark University, Worcester, Mass.*	1908
Thaxter, Roland.	*Harvard University, Cambridge, Mass.*	1912
Thomson, Elihu.	*Swampscott, Mass.*	1907
Trelease, William.	*University of Illinois, Urbana, Ill.*	1902
Trowbridge, John.	*Harvard University, Cambridge, Mass.*	1878
Van Hise, C. R.	*University of Wisconsin, Madison, Wis.*	1902
Van Vleck, E. B.	*University of Wisconsin, Madison, Wis.*	1911
Vaughan, Victor Clarence.	*University of Michigan, Ann Arbor, Mich.*	1915
Verrill, A. E.	*Yale University, New Haven, Conn.*	1872
Walcott, Charles D.	*Smithsonian Institution, Washington, D. C.*	1896
Webster, Arthur G.	*Clark University, Worcester, Mass.*	1903
Welch, William H.	*807 St. Paul St., Baltimore, Md.*	1895
Wells, Horace L.	*Yale University, New Haven, Conn.*	1903
Wheeler, William M.	*Harvard University, Cambridge, Mass.*	1912
White, David.	*U. S. Geological Survey, Washington, D. C.*	1912
White, Henry Seely.	*Vassar College, Poughkeepsie, N. Y.*	1915
Williston, Samuel Wendell.	*University of Chicago, Chicago, Ill.*	1915
Wilson, Edmund B.	*Columbia University, New York City.*	1899
Wood, Horatio C.	*4107 Chester Ave., Philadelphia, Pa.*	1879
Wood, Robert W.	*Johns Hopkins University, Baltimore, Md.*	1912
Woodward, Robert S.	*Carnegie Institution, Washington, D. C.*	1896

HONORARY MEMBER.

Smith, Sidney I.	*Yale University, New Haven, Conn.*	1884

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FOREIGN ASSOCIATES.

		Date of election.
ARRHENIUS, S. A.	*Nobelinstitut, Stockholm.*	1908
BACKLUND, OSKAR	*Astronomical Observatory, Poulkova.*	1903
BAEYER, ADOLPH RITTER VON	*Universität, Munich.*	1898
BARROIS, CHARLES	*Université, Lille.*	1908
BRØGGER, W. C.	*Universitet, Christiania.*	1903
CROOKES, SIR WILLIAM	*London.*	1913
DARBOUX, GASTON	*Academy of Sciences, Paris.*	1913
DESLANDRES, HENRI	*Astrophysical Observatory, Meudon.*	1913
DEWAR, SIR JAMES	*University, Cambridge.*	1907
FISCHER, EMIL	*Chemisches Institut der Universität, Berlin.*	1904
FORSYTH, A. R.	*Trinity College, Cambridge.*	1907
GEIKIE, SIR ARCHIBALD	*Haslemere, Surrey.*	1901
GROTH, PAUL VON	*Universität, Munich.*	1905
HEIM, ALBERT	*Zürich.*	1913
HILBERT, DAVID	*Universität, Göttingen.*	1907
KAPTEYN, JOHN C.	*Rijks Universiteit, Groningen.*	1907
KLEIN, FELIX	*Universität, Göttingen.*	1898
KÖSSEL, ALBRECHT	*Heidelberg.*	1913
KUSTNER, KARL FRIEDRICH	*Bonn.*	1913
LANKESTER, E. RAY	*South Kensington, London.*	1903
LARMOR, SIR JOSEPH	*St. Johns College, Cambridge.*	1908
LORENTZ, HENDRIK ANTON	*Rijks Universiteit, Leiden.*	1906
OSTWALD, WILHELM	*Grossbothen, bei Leipzig.*	1906
PAVLOV, IVAN PETROVITCH	*Imperial Institute for Experimental Medicine, Petrograd.*	1908
PENCK, ALBRECHT	*Universität, Berlin.*	1909
PFEFFER, WILHELM	*Botanische Institut der Universität, Leipzig.*	1903
PICARD, CHARLES ÉMILE	*Université, Paris.*	1903
RAMSAY, SIR WILLIAM	*University College, London.*	1904
RAYLEIGH, LORD	*University, Cambridge.*	1898
RETZIUS, GUSTAV	*Högskolan, Stockholm.*	1909
RUTHERFORD, ERNEST	*University, Manchester.*	1911
SCHUSTER, ARTHUR	*Secretary of the Royal Society, London.*	1913
SEELIGER, HUGO RITTER VON	*Universität, Munich.*	1908
THOMSON, SIR JOSEPH	*University, Cambridge.*	1903
VOLTERRA, VITO	*Università, Rome.*	1911
VRIES, HUGO DE	*Universiteit, Amsterdam.*	1904
WAALS, JOHANNES D. VAN DER	*Amsterdam.*	1913
WALDEYER, WILHELM	*Universität, Berlin.*	1909
WOLF, MAX F. J. C.	*Heidelberg.*	1913
WUNDT, WILHELM	*Universität, Leipzig.*	1909

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DECEASED MEMBERS.

	Date of election.	Date of death.
AGASSIZ, ALEXANDER	1866	Mar. 27, 1910
AGASSIZ, LOUIS	(1)	Dec. 14, 1873
ALEXANDER, J. H.	(1)	Mar. 2, 1867
ALEXANDER, STEPHEN	(1)	June 25, 1883
BACHE, ALEXANDER DALLAS	(1)	Feb. 14, 1867
BAIRD, SPENCER F.	1864	Aug. 19, 1887
BARKER, GEORGE F.	1876 [2]	May 24, 1910
BARNARD, F. A. P.	(1) (2)	Apr. 27, 1889
BARNARD, J. G.	(1)	May 14, 1882
BARTLETT, W. H. C.	(1)	Feb. 11, 1893
BEECHER, CHARLES EMERSON	1899	Feb. 14, 1904
BILLINGS, JOHN S.	1883 [2]	Mar. 11, 1913
BOSS, LEWIS	1889 [2]	Oct. 5, 1912
BOWDITCH, HENRY P.	1887 [2]	Mar. 13, 1911
BREWER, WILLIAM H.	1880 [2]	Nov. 2, 1910
BROOKS, WILLIAM KEITH	1884	Nov. 12, 1908
BROWN-SEQUARD, CHARLES E.	1868	Apr. 2, 1894
BRUSH, GEORGE JARVIS	1868 [2]	Feb. 6, 1912
CASEY, THOMAS L.	1890	Mar. 25, 1896
CASWELL, ALEXIS	(1)	Jan. 8, 1887
CHANDLER, SETH CARLO	1888 [2]	Jan. 10, 1914
CHAUVENET, WILLIAM	(1)	Dec. 13, 1870
CLARKE, HENRY JAMES	1872	July 1, 1873
COFFIN, JAMES	1869	Jan. 6, 1873
COFFIN, J. H. C.	(1)	Jan. 8, 1890
COMSTOCK, CYRUS B.	1884	May 29, 1910
COOK, GEORGE H.	1887	Sept. 22, 1889
COOKE, JOSIAH P.	1872	Sept. 3, 1894
COPE, EDWARD D.	1872 [2]	Apr. 12, 1897
COUES, ELLIOTT	1877	Dec. 25, 1899
DALTON, J. C.	1864	Feb. 2, 1889
DANA, JAMES D.	(1) (2)	Apr. 14, 1895
DAVIDSON, GEORGE	1874 [2]	Dec. 2, 1911
DAVIS, CHARLES H.	(1)	Feb. 14, 1877
DRAPER, HENRY	1877	Nov. 20, 1882
DRAPER, JOHN W.	1877	Jan. 4, 1882
DUTTON, C. E.	1884 [2]	Jan. 4, 1912
EADS, JAMES B.	1872	Mar. 8, 1887
EMMONS, SAMUEL F.	1892	Mar. 28, 1911
ENGLEMANN, GEORGE	(1)	Feb. 4, 1884
FERREL, WILLIAM	1868	Sept. 18, 1891
FRASER, JOHN FRIES	(1)	Oct. 12, 1872
GABB, WILLIAM M.	1876	May 30, 1878
GESTH, F. A.	1872	Feb. 2, 1893
GIBBS, JOSIAH WILLARD	1879	Apr. 28, 1903
GIBBS, WOLCOTT	(1)	Dec. 9, 1908
GILL, THEODORE NICHOLAS	1873 [2]	Sept. 25, 1914
GILLIS, JAMES MELVILLE	(1)	Feb. 9, 1865
GOODE, G. BROWN	1888	Sept. 6, 1896
GOULD, AUGUSTUS A.	(1)	Sept. 15, 1866
GOULD, BENJAMIN A.	(1) (2)	Nov. 27, 1896
GRAY, ASA	(1)	Jan. 30, 1888
GUYOT, ARNOLD	(1)	Feb. 8, 1884

[1] Charter members, March 3, 1863. [2] Biographical notices have not been presented.

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Deceased members—Continued.

	Date of election.	Date of death.
HADLEY, JAMES	1864	Aug. 1, 1872
HALDEMAN, S. S	1876	Sept. 20, 1890
HALL, ASAPH	1875	Nov. 22, 1907
HALL, JAMES	(1) (2)	Aug. 8, 1898
HAYDEN, F. V	1873	Dec. 22, 1887
HENRY, JOSEPH	(1)	May 13, 1878
HILGARD, JULIUS E	(1)	May 8, 1891
HILL, GEORGE WILLIAM	1874	Apr. 6, 1914
HILL, HENRY B	1883	Apr. 6, 1903
HITCHCOCK, EDWARD	(1)	Feb. 27, 1864
HOLBROOK, J. E	1868	Sept. 8, 1871
HOLDEN, EDWARD SINGLETON	1885 [2]	Mar. 16, 1914
HUBBARD, J. S	(1)	Aug. 16, 1863
HUMPHREYS, A. A	(1)	Nov. 28, 1883
HUNT, T. STERRY	1873 [2]	Feb. 12, 1892
HYATT, ALPHEUS	1875	Jan. 16, 1902
JOHNSON, S. W	1866	July 21, 1909
KEELER, J. E	1900	Aug. 12, 1900
KING, CLARENCE	1876	Dec. 24, 1901
KIRTLAND, JARED P	1865	Dec. 10, 1877
LANE, J. HOMER	1872	May 3, 1880
LANGLEY, SAMUEL P	1876	Feb. 27, 1906
LEA, MATTHEW CAREY	1892	Mar. 15, 1897
LE CONTE, JOHN	1878	Apr. 29, 1891
LE CONTE, JOHN L	(1)	Nov. 15, 1883
LE CONTE, JOSEPH	1875	July 6, 1901
LEIDY, JOSEPH	(1)	Apr. 30, 1891
LESLEY, J. PETER	(1)	June 3, 1903
LESQUEREUX, LEO	1864	Oct. 25, 1889
LONGSTRETH, MIERS F	(1)	Dec. 27, 1891
LOOMIS, ELIAS	1873	Aug. 16, 1889
LOVERING, JOSEPH	1873	Jan. 18, 1892
LYMAN, THEODORE	1872	Sept. 10, 1897
MAHAN, D. H	(1)	Sept. 16, 1871
MARSH, G. P	1866	July 23, 1882
MARSH, O. C	1874 [2]	Mar. 18, 1889
MAYER, ALFRED M	1872	July 13, 1897
MAYO-SMITH, RICHMOND	1890 [2]	Nov. 11, 1901
MEEK, F. B	1869	Dec. 21, 1877
MEIGS, M. C	1865	Jan. 2, 1892
MINOT, CHARLES SEDGWICK	1897 [2]	Nov. 19, 1914
MITCHELL, HENRY	1885 [2]	Dec. 1, 1902
MITCHELL, SILAS WEIR	1865 [2]	Jan. 4, 1914
MORGAN, LEWIS H	1875	Dec. 14, 1881
MORTON, HENRY	1874	May 9, 1902
NEF, JOHN ULRIC	1904 [2]	Aug. 13, 1915
NEWBERRY, J. S	(1)	Dec. 7, 1892
NEWCOMB, SIMON	1869 [2]	July 11, 1909
NEWTON, H. A	(1)	Aug. 1, 1896
NEWTON, JOHN	1876	May 1, 1895
NORTON, WILLIAM A	1873	Sept. 21, 1883
OLIVER, JAMES E	1872	Mar. 27, 1895
PACKARD, A. S	1872 [2]	Feb. 14, 1905
PIERCE, BENJAMIN OSGOOD	1906 [2]	Jan. 14, 1914

[1] Charter members, March 3, 1863. [2] Biographical notices have not been presented.

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Deceased members—Continued.

	Date of election.	Date of death.
PIERCE, CHARLES SANTIAGO SANDERS	1876 [2]	Apr. 20, 1914
PENFIELD, SAMUEL L.	1900	Aug. 13, 1906
PETERS, C. H. F.	1876 [2]	July 18, 1890
POURTALES, L. F.	1873	July 19, 1880
POWELL, JOHN W.	1880	Sept. 23, 1902
PUTNAM, FREDERICK W.	1885 [2]	Aug. 14, 1915
RODGERS, JOHN	(1)	May 5, 1882
ROGERS, FAIRMAN	(1)	Aug. 23, 1900
ROGERS, ROBERT E.	(1)	Sept. 7, 1884
ROGERS, WILLIAM A.	1885	Mar. 1, 1898
ROGERS, WILLIAM B.	(1)	May 30, 1882
ROOD, OGDEN N.	1885	Nov. 12, 1902
ROWLAND, HENRY A.	1881	Apr. 16, 1901
RUTHERFURD, LEWIS M.	(1)	May 30, 1892
SAXTON, JOSEPH	(1)	Oct. 26, 1873
SCHOTT, CHARLES A.	1872	July 31, 1901
SCUDDER, SAMUEL H.	1877 [2]	May 17, 1911
SELLERS, WILLIAM	1873 [2]	Jan. 24, 1905
SILLIMAN, BENJ., Sr	(1)	Nov. 24, 1864
SILLIMAN, BENJ., Jr.	(1)	Jan. 14, 1885
SMITH, J. LAWRENCE	1872	Oct. 12, 1883
STIMPSON, WILLIAM	1868 [2]	May 26, 1873
STRONG, THEODORE	(1)	Feb. 1, 1869
SULLIVANT, W. S.	1873	Apr. 30, 1882
TORREY, JOHN	(1)	Mar. 10, 1873
TOTTEN, J. G.	(1)	Apr. 22, 1864
TROWBRIDGE, WILLIAM P.	1872	Aug. 12, 1892
TRUMBULL, JAMES H.	1872	Aug. 5, 1897
TUCKERMAN, EDWARD	1868	Mar. 15, 1886
WALKER, FRANCIS A.	1878	Jan. 5, 1897
WARREN, G. K.	1876	Aug. 8, 1882
WATSON, JAMES C.	1868	Nov. 23, 1880
WATSON, SERENO	1889	Mar. 9, 1892
WHEELER, HENRY LORD	1909 [2]	Oct. 30, 1914
WHITE, CHARLES A.	1889	June 29, 1910
WHITMAN, C. O.	1895	Dec. 6, 1910
WINLOCK, JOSEPH	(1)	June 11, 1875
WOODWARD, J. J.	1873	Aug. 17, 1884
WORTHEN, A. H.	1872	May 6, 1888
WRIGHT, ARTHUR WILLIAMS	1881 [2]	Dec. 19, 1915
WYMAN, JEFFRIES	(1)	Sept. 4, 1874
YOUNG, CHARLES A.	1872	Jan. 3, 1908

[1] Charter members, March 3, 1863.

[2] Biographical notices have not been presented.

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DECEASED FOREIGN ASSOCIATES.

ADAMS, J. C.
AIRY, SIR GEORGE B.
ARGELANDER, F. W. A.
AUWERS, G. F. J. ARTHUR
BAER, KARL ERNEST VON
BARRANDE, JOACHIM
BEAUMONT, L. ÉLIE DE
BECQUEREL, HENRI
BERTHELOT, M. P. E.
BERTRAND, J. L. F.
BOLTZMANN, LUDWIG
BORNET, EDOUARD
BOUSSINGAULT, J. B. J. D.
BOVERI, THEODOR
BRAUN, ALEXANDER
BREWSTER, SIR DAVID
BUNSEN, ROBERT W.
BURMEISTER, C. H. C.
CANDOLLE, ALPHONSE DE
CAYLEY, ARTHUR
CHASLES, MICHEL
CHEVREUL, M. E.
CLAUSIUS, RUDOLPH
CORNU, ALFRED
DARWIN, SIR GEORGE HOWARD
DOVE, H. W.
DUMAS, J. B.
EHRLICH, PAUL
FARRADAY, MICHAEL
GEGENBAUR, KARL
GLYDÉN, HUGO
GILL, SIR DAVID
HAMILTON, SIR WILLIAM ROWAN
HELMHOLTZ, BARON H. VON
HOFF, J. H. VAN'T
HOFMANN, A. W.
HOOKER, SIR JOSEPH D.
HUGGINS, SIR WILLIAM
HUXLEY, T. H.
IBAÑEZ, CARLOS
JANSSEN, J.
JOULE, JAMES P.
KEKULÉ, AUGUST
KELVIN, LORD
KIRCHOFF, G. R.
KOCH, ROBERT
KOHLRAUSCH, FRIEDRICH
KÖLLIKER, ALBERT VON
KRONECKER, HUGO
LACAZE-DUTHIERS, HENRI DE
LEUCKART, RUDOLPH
LIE, SOPHUS
LIEBIG, JUSTUS VON
LISTER, LORD
LOEWY, MAURICE
LUDWIG, K. F. W.
MAREY, E. J.
MENDELÉEFF, D. I.
MILNE-EDWARDS, HENRI
MOISSAN, HENRI
MURCHISON, SIR RODERICK I.
MURRAY, SIR JOHN
OPPOLZER, THEODORE VON
OWEN, SIR RICHARD
PASTEUR, LOUIS
PETERS, C. A. F.
PLANA, G. A. A.
POINCARÉ, JULES HENRI
RAMMELSBERG, C. F.
REGNAULT, VICTOR
REYMOND, EMIL DU BOIS
RICHTHOFEN, F. VON
ROSENBUSCH, KARL HARRY FERDINAND
SACHS, JULIUS VON
SCHIAPARELLI, GIOVANNI
STAS, JEAN SERVAIS
STOKES, SIR GEORGE G.
STRASBURGER, EDOUARD
STRUVE, OTTO VON
SUESS, EDUARD
SYLVESTER, J. J.
TISSERAND, F. F.
VIRCHOW, RUDOLPH VON
VOGEL, H. C.
WEIERSTRASS, KARL
WEISMANN, AUGUST
WÖHLER, FRIEDRICH
WÜRTZ, ADOLPH
ZIRKEL, FERDINAND
ZITTEL, K. A. R. VON

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REPORT

OF THE

NATIONAL ACADEMY OF SCIENCES

FOR THE YEAR

1916

WASHINGTON
GOVERNMENT PRINTING OFFICE
1917

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REPORT

OF THE

NATIONAL ACADEMY OF SCIENCES

FOR THE YEAR

1916

WASHINGTON
GOVERNMENT PRINTING OFFICE
1917

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SENATE RESOLUTION NO. 361.

[Reported by Mr. Chilton.]

IN THE SENATE OF THE UNITED STATES,
February 13, 1917.

Resolved, That the manuscript entitled "Report of the National Academy of Sciences for the year ended December 31, 1916," be printed as a Senate Document.

Attest:

JAMES M. BAKER,
Secretary.

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CONTENTS.

	Page.
Letter of transmittal	5
Act of incorporation	7
Amendments	8
Meetings of the National Academy, 1916	13
Annual meeting—	
Members in attendance	13
Business sessions	14
Announcement of deaths	14
Panama Canal slides	14
Reports of the president and treasurer	14
Report of the home secretary	14
Report of the foreign secretary	15
Report of the directors of the Bache fund	16
Report of the trustees of the Watson fund	17
Report of the committee on the Henry Draper fund	17
Report of the committee on the J. Lawrence Smith fund	18
Report of the directors of the Benjamin Apthorp Gould fund	18
Report of the trustees of the Wolcott Gibbs fund	19
Report of the committee on the Comstock fund	19
Report of the Committee on the Murray fund	19
Business from the council	20
Dues for 1916	20
Date for elections	20
International Association of Academies	20
Fiscal advisers of the academy	20
Autumn meeting	20
Sections	20
Engineers	20
Centigrade and Fahrenheit scales	20
Universal alphabet	20
Trust funds	21
Report of the editorial board of the Proceedings	21
Amendments to the constitution	22
National Research Council	22
Exhibit at meetings	22
Trust funds	22
Amendment to Rule IV	22
Committee on paleontologia universalis	23
American Academy of political and social science	23
Pacific exploration	23
Joseph A. Holmes Safety Association	23
Biographical memoirs	23
Cooperation with engineers	23
Centigrade and Fahrenheit scales	24
Election of foreign secretary	24
Election of new members of the council	24
Election of new members	25
Autumn meeting—time and place	25
Committee announcements	25
Presentation of medals, 1916	26

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Meetings of the National Academy, 1916—Continued.
Annual meeting—Continued.
Scientific sessions— Page.
April 17 ... 26
April 18 ... 28
April 19 ... 29
Autumn meeting ... 29
Members in attendance ... 29
Business sessions—
Announcement of deaths since annual meeting ... 29
Publications issued ... 29
Editorial board changes ... 29
Committee announcements ... 30
National Research Council ... 30
New members presented ... 30
Marsh fund ... 30
Section of engineering ... 30
Amendments to the constitution ... 30
Report of the National Research Council ... 31
Report of the committee on Panama Canal slides ... 36
Minutes ... 36
Proceedings ... 36
J. Lawrence Smith fund ... 36
Marsh fund ... 36
Report of the committee on the Medal for Eminence in the Application of Science to the Public Welfare ... 37
Biographical memoirs ... 37
Report of the committee on Synthetic Organic Chemistry ... 37
Scientific sessions—
November 13 ... 37
November 14 ... 38
Scientific exhibits ... 39
Henry Draper medalists ... 42
Deceased members:
Arthur Williams Wright ... 42
Josiah Royce ... 44
Eugene Woldemar Hilgard ... 50
Cleveland Abbe ... 52
Annual report of the treasurer:
General review of financial transactions ... 54
Statement of assets and liabilities ... 55
Condensed statement of receipts and expenditures ... 58
Accounts with individual funds ... 61
Report of auditing committee ... 66
Appendices:
Appendix A.—Constitution of the National Academy ... 69
Appendix B.—Rules ... 76
Appendix C.—Organization of the academy, 1916-17 ... 82
Sections ... 82
Standing committees ... 84
Trust funds ... 84
Members of the National Academy of Sciences, December 31, 1916 ... 87
Honorary member ... 90
Foreign associates ... 90
Deceased members ... 91
Deceased foreign associates ... 94

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LETTER OF TRANSMITTAL.

NATIONAL ACADEMY OF SCIENCES,
January 27, 1917.

The Honorable THOMAS R. MARSHALL,
Vice President of the United States,
Washington, D. C.

SIR: I have the honor to transmit to you herewith the annual report of the president of the National Academy of Sciences for the year ending December 31, 1916.

Very respectfully,

ARTHUR L. DAY,
Home Secretary.

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ACT OF INCORPORATION.

AN ACT To incorporate the National Academy of Sciences.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That Louis Agassiz, Massachusetts; J. H. Alexander, Maryland; S. Alexander, New Jersey; A. D. Bache, at large; F. B. Barnard,[1] at large; J. G. Barnard, United States Army, Massachusetts; W. H. C. Bartlett, United States Military Academy, Missouri; U. A. Boyden,[2] Massachusetts; Alexis Caswell, Rhode Island; William Chauvenet, Missouri; J. H. C. Coffin, United States Naval Academy, Maine; J. A. Dahlgren,[2] United States Navy, Pennsylvania; J. D. Dana, Connecticut; Charles H. Davis, United States Navy, Massachusetts; George Engelmann, Saint Louis, Missouri; J. F. Frazer, Pennsylvania; Wolcott Gibbs, New York; J. M. Gilless,[3] United States Navy, District of Columbia; A. A. Gould, Massachusetts; B. A. Gould, Massachusetts; Asa Gray, Massachusetts; A. Guyot, New Jersey; James Hall, New York; Joseph Henry, at large; J. E. Hilgard, at large, Illinois; Edward Hitchcock, Massachusetts; J. S. Hubbard, United States Naval Observatory, Connecticut; A. A. Humphreys, United States Army, Pennsylvania; J. L. Le Conte, United States Army, Pennsylvania; J. Leidy, Pennsylvania; J. P. Lesley, Pennsylvania; M. F. Longstreth, Pennsylvania; D. H. Mahan, United States Military Academy, Virginia; J. S. Newberry, Ohio; H. A. Newton, Connecticut; Benjamin Peirce, Massachusetts; John Rodgers, United States Navy, Indiana; Fairman Rogers, Pennsylvania; R. E. Rogers, Pennsylvania; W. B. Rogers, Massachusetts; L. M. Rutherford, New York; Joseph Saxton, at large; Benjamin Silliman, Connecticut; Benjamin Silliman, junior, Connecticut; Theodore Strong, New Jersey; John Torrey, New York; J. G. Totten, United States Army, Connecticut; Joseph Winlock, United States Nautical Almanac, Kentucky; Jeffries Wyman, Massachusetts; J. D. Whitney, California; their associates and successors duly chosen, are hereby incorporated, constituted, and declared to be a body corporate, by the name of the National Academy of Sciences.

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[1] The official list of members gives the name of F. A. P. Barnard.
[2] Declined.
[3] The official list of members gives the name of J. M. Gillis.

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SEC. 2. *And be it further enacted*, That the National Academy of Sciences shall consist of not more than fifty ordinary members, and the said corporation hereby constituted shall have power to make its own organization, including its constitution, by-laws, and rules and regulations; to fill all vacancies created by death, resignation, or otherwise; to provide for the election of foreign and domestic members, the division into classes, and all other matters needful or usual in such institution, and to report the same to Congress.

SEC. 3. *And be it further enacted*, That the National Academy of Sciences shall hold an annual meeting at such place in the United States as may be designated, and the academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art, the actual expense of such investigations, examinations, experiments, and reports to be paid from appropriations which may be made for the purpose, but the academy shall receive no compensation whatever for any services to the Government of the United States.

Approved, March 3, 1863.

AMENDMENTS.

AN ACT To amend the act to incorporate the National Academy of Sciences.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the act to incorporate the National Academy of Sciences, approved March third, eighteen hundred and sixty-three, be, and the same is hereby, so amended as to remove the limitation of the number of ordinary members of said academy as provided in said act.

Approved, July 14, 1870.

AN ACT To authorize the National Academy of Sciences to receive and hold trust funds for the promotion of science, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the National Academy of Sciences, incorporated by the act of Congress, approved March third, eighteen hundred and sixty-three, and its several supplements, be, and the same is hereby, authorized and empowered to receive bequests and donations and hold the same in trust, to be applied by the said academy in aid of scientific investigations and according to the will of the donors.

Approved, June 20, 1884.

AN ACT To amend the act authorizing the National Academy of Sciences to receive and hold trust funds for the promotion of science, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the act to authorize the National Academy of Sciences to receive and hold

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trust funds for the promotion of science, and for other purposes, approved June twentieth, eighteen hundred and eighty-four, be, and the same is hereby, amended to read as follows:

"That the National Academy of Sciences, incorporated by the act of Congress approved March third, eighteen hundred and sixty-three, be, and the same is hereby, authorized and empowered to receive, by devise, bequest, donation, or otherwise, either real or personal property, and to hold the same absolutely or in trust, and to invest, reinvest, and manage the same in accordance with the provisions of its constitution, and to apply said property and the income arising therefrom to the objects of its creation and according to the instructions of the donors: *Provided, however*, That the Congress may at any time limit the amount of real estate which may be acquired and the length of time the same may be held by said National Academy of Sciences."

SEC. 2. That the right to alter, amend, or repeal this act is hereby expressly reserved.

Approved, May 27, 1914.

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ANNUAL REPORT

OF THE

NATIONAL ACADEMY OF SCIENCES.

During the past year two commissions have been given to the academy by the President of the United States, each of which bears very directly upon the public welfare. The first directed the academy to examine into the nature and consequences of the landslides which have blocked the passage of the Panama Canal from time to time; the second called upon the academy to take the initiative in ascertaining and correlating the resources for research (men, equipment, and experience) of the country, which may be applied to the solution of the scientific problems which are constantly arising just now in the preparations to meet impending national emergencies.

The examination of the canal slides was undertaken by a committee of 12 geologists and engineers, all men of national reputation, and their decision is of a kind to invite and to receive general attention at this time. Public confidence in the canal was rather seriously shaken when the great waterway remained closed to traffic for some months with no certainty that when cleared again it might not be closed by further slides within a few days or weeks. The strain upon shippers and upon the American public, which has taken an active interest and pride in the greatest engineering undertaking of our time, has been very severe.

The final report of the committee, though not yet in print, goes far to relieve this apprehension. The geologists of the academy committee assure us that there is no further ground for serious apprehension; that the mass of material in motion is now continually diminishing in magnitude, and although further slips are to be expected, they can not attain the volume of those that are past, nor can they any longer be accounted a serious menace to the full and complete usefulness of the canal in transporting the heaviest traffic from ocean to ocean.

The report of the committee will soon appear in print as a separate document.

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The second charge which was given to the academy is a direct consequence of a resolution taken at the annual meeting of the academy in April, 1916, as follows:

Resolved, That the President of the Academy be requested to inform the President of the United States that in the event of a break in diplomatic relations with any other country the academy desires to place itself at the disposal of the Government for any service within its scope.

When this resolution was brought to the attention of the President, he desired that the academy should take the initiative in ascertaining and correlating the scientific resources of the country which might be depended upon for the solution of problems arising out of the movement for "preparedness" against the possibility of war.

The council of the academy took immediate action upon the request and organized an independent body with power to act, which has been called the National Research Council. The explicit purposes of this research council as set forth in a prospectus recently issued are the following:

(1) The preparation of a national inventory of equipment for research, of the men engaged in it, and of the lines of investigation pursued in cooperating Government bureaus, educational institutions, research foundations, and industrial research laboratories—this inventory to be prepared in harmony with any general plan adopted by the Government Council of National Defense.

(2) The preparation of reports by special committees, leading to the statement of important research problems and thus serving as a clearing house for the coordination of research in various departments of science.

(3) The promotion of cooperation in research with the object of securing increased efficiency, but with careful avoidance of any hampering control or interference with individual freedom and initiative.

(4) Cooperation with educational institutions, by supporting their efforts to secure larger funds and more favorable conditions for the pursuit of research and for the training of students in the methods and spirit of investigation.

(5) Cooperation with research foundations and other agencies desiring to secure a more effective use of funds available for investigation.

(6) The encouragement in cooperating laboratories, of researches designed to strengthen the national defense and to render the United States independent of foreign sources of supply liable to be affected by war.

It is at once obvious that the value to the National Government of the information now being gathered in pursuit of this plan is very great, and there is a consequence which is by no means secondary in

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importance in the effect which its work has had in stimulating scientific activity throughout the country. Both educational institutions and industrial organizations are planning research work as never before.

It is still too early perhaps to appraise properly the ultimate scope or effect of the present effort, but it is certain to surpass all expectations, both in the amount of information which will become available to meet national needs and in the wonderful stimulus given to the movement for scientific investigation and research, not to mention the gain in efficiency in such studies through closer coordination than has been possible heretofore. A report of the activities of the council for the first year of its existence will be found on a later page (p. 31), together with a list of its members.

MEETINGS OF THE NATIONAL ACADEMY.

During the year 1916 the academy held two stated meetings, the annual meeting in April, at Washington, and the autumn meeting in November, at Boston, Mass.

ANNUAL MEETING.

The sessions were held in the United States National Museum and in the Oak Room of the Raleigh Hotel, Washington, D. C., April 17, 18, 19, 1916. Seventy-one members were present, as follows:

Abbot, Charles Greeley.
Allen, J. Asaph.
Ames, J. S.
Becker, George F.
Boltwood, B. B.
Britton, Nathaniel Lord.
Bumstead, Henry Andrews.
Campbell, D. H.
Cannon, Walter Bradford.
Cattell, James McKeen.
Clark, W. B.
Clarke, F. W.
Clarke, J. M.
Comstock, George C.
Conklin, E. G.
Coulter, J. M.
Cross, Whitman.
Dall, William H.
Davenport, C. B.
Davis, William Morris.
Day, Arthur L.
Donaldson, Henry Herbert.
Fewkes, Jesse Walter.
Flexner, Simon.
Hague, Arnold.
Hale, George E.
Hall, E. H.
Harper, R. A.
Hayford, John F.
Hillebrand, W. F.
Holmes, William H.
Howell, William H.
Iddings, Joseph.
Jennings, Herbert Spencer.
Leuschner, Armin O.
Lillie, Frank Rattray.
Loeb, Jacques.
Lusk, Graham.
Mall, F. P.
Meltzer, Samuel James.
Mendel, Lafayette B.
Merriam, C. Hart.
Merritt, Ernest.
Millikan, Robert Andrews.
Moore, Eliakim H.
Morley, Edward W.
Morse, H. N.
Moulton, F. R.

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Nichols, E. L.
Noyes, Arthur A.
Parker, George H.
Pickering, Edward C.
Pupin, M. I.
Ransome, Frederick Leslie.
Reid, H. Fielding.
Remsen, Ira.
Rosa, Edward B.
Schuchert, Charles.
Scott, William B.
Smith, Erwin F.
Story, William E.
Van Hise, C. R.
Van Vleck, E. B.
Walcott, Charles D.
Webster, Arthur G.
Welch, William H.
Wheeler, William M.
White, David.
White, H. S.
Wilson, Edmund B.
Wood, R. W.
Woodward, R. S.

BUSINESS SESSIONS.

ANNOUNCEMENT OF DEATHS.

The president announced the deaths since the autumn meeting of four members and two foreign associates:

Members.—John Ulric Nef, elected in 1904, died on August 13, 1915.

Frederick Ward Putnam, elected in 1885, died on August 18, 1915.

Arthur W. Wright, elected in 1881, died on December 19. 1915.

Eugene W. Hilgard, elected in 1872, died on January 8, 1916.

Foreign associate.—Paul Erhlich, elected in 1904, died on August 20, 1915.

The president announced that the preparation of biographical memoirs of deceased members had been assigned as follows: John Ulric Nef to J. O. Stieglitz, Frederick Ward Putnam to Jesse Walter Fewkes.

PANAMA CANAL SLIDES.

The president stated that a preliminary report of the committee to investigate the slides at the Panama Canal had been prepared and transmitted by him to the President of the United States and that the final report was in process of completion and would in turn be transmitted to the President of the United States. The preliminary report is printed in full in the proceedings of the academy.

REPORTS OF THE PRESIDENT AND THE TREASURER.

The reports of the president[1] and of the treasurer[2] for 1915, as transmitted to the Senate of the United States by the President of the Academy, were presented in their printed form and approved.

REPORT OF THE HOME SECRETARY.

The PRESIDENT OF THE NATIONAL ACADEMY OF SCIENCES.

SIR: I have the honor to present the following report on the publications and membership of the National Academy of Sciences for the year ending April 19, 1916.

[1] Report of the National Academy of Sciences for the year 1915, pp. 11–30.
[2] Idem, pp. 36–45.

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The memoirs of the National Academy of Sciences, volume 12, part 2, entitled, "Variations and Ecological Distribution of the Snails of the Genus Io." by Charles C. Adams, has been published and distributed, as has also the memoir forming volume 13, entitled "A Catalogue of the Meteorites of North America," by Oliver C. Farrington. Volume 14, memoir 1, entitled, "Report on Researches on the Chemical and Mineralogical Composition of Meteorites, with Especial Reference to Their Minor Constituents," by George Perkins Merrill, is in press and the final proof has been passed. It awaits casting and printing before it is published.

The biographical memoirs of John W. Powell, Miers Fisher Longstreth, Charles Anthony Schott, Peter Lesley, Henry Morton, and Alfred Marshall Mayer have been published and distributed, and that of George William Hill, by Ernest W. Brown, is also published but has not been distributed.

Three members have died since the last Annual Meeting: John Ulric Nef, on August 13, 1915, elected in 1904; Frederick W. Putnam, on August 18, 1915, elected in 1885; Arthur W. Wright, on December 19, 1915, elected in 1881; and Eugene W. Hilgard, on January 8, 1916, elected in 1872.

One foreign associate, Paul Erhlich, died on August 20, 1915.

There are 139 active members on the membership list, 1 honorary member, and 39 foreign associates.

ARTHUR L. DAY, *Home Secretary.*

REPORT OF THE FOREIGN SECRETARY.

I have the honor to report on the work of the foreign secretary for the year ending April 19, 1916.

An attempt has been made, through correspondence with various academies and societies belonging to the International Association of Academies, to secure a partial continuance of some portions of the Association's work through the period of the war. Although international meetings are obviously not feasible, it was hoped that a temporary transfer of the functions of leading academy from Berlin to Amsterdam, as suggested by the former body, might serve a useful purpose. Unfortunately, however, certain difficulties of an insuperable nature prevented the proposed transfer, and no further steps can be taken at present.

It was suggested to the Amsterdam Academy by the foreign secretary, also acting in the capacity of secretary of a joint committee of the National Academy and the American Association, that the Accademia dei Lincei be requested to use its good offices to secure the continuation of the work of the Zoological Station at Naples. A favorable reply was received from the president of the Lincei, but the participation of Italy in the war has prevented Dr. Dohrn from retaining the direction of the station, which is now under an Italian administration.

At the request of the president of the Amsterdam Academy, who is also permanent secretary of the International Geodetic Association, the Secretary of State was asked by the academy to use his influence to secure the continued participation of the United States in the work of the association, and the maintenance of the international latitude station at Ukiah, Cal. Through the action of the Secretary of State, and the interest of Members of Congress, the necessary appropriations have been provided.

GEORGE E. HALE,
Foreign Secretary.

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REPORT OF THE DIRECTORS OF THE BACHE FUND.

Mr. Ira Remsen resigned as director of the fund at the annual meeting, 1915. The two remaining members of the committee chose Mr. Arthur G. Webster as the third member, and later the undersigned was elected chairman. Since the annual meeting the following appropriations have been made:

No. 187, to H. H. Lane, State University of Oklahoma, $500, for the purchase of apparatus to be used in a comparative study of the embryos and young of various mammals in order to determine, by physiological experimentation and morphological observations, the correlation between structure and function in the development of the special senses.

No. 188, to H. W. Norris, Grinnell College, $100, for assistance in the analysis of the cranial nerves of Coecilians (Herpele and Dermophis).

No. 189, to E. J. Werber, Woods Hole, $230, for assistance in experimental studies aiming at the control of defective and monstrous developments; (1) the effect of the toxic products of metabolism on the developing teleost egg; (2) the effect of experimentally produced diseases of parental metabolism on the offspring of mammals.

No. 190, to H. S. Jennings, Johns Hopkins University, $200, for assistance in the study of evolution in a unicellular animal multiplying by fission: heredity, variation, racial differentiation in *Difflugia*.

No. 191, to P. W. Bridgman, Harvard University, $500, for mechanical assistance in an investigation of various effects of high hydrostatic pressure, in particular the effect of pressure on electrical resistance of metals (continuation).

No. 192, to J. P. Iddings, Washington, D. C., $1,000, for apparatus and assistance in the microscopical and chemical investigation of igneous rocks for the purpose of extending knowledge regarding petrographical provinces and their bearings on the problem of isostasy.

No. 193, to C. A. Kofoid, University of California, $500, for assistance in securing animals in the Indian jungle and in their preparation for study in research on the intestinal protozoa.

No. 194, to R. A. Daly, Harvard University, $1,000, for the purchase of a thermograph of new design for determining temperatures in the deep sea.

No. 195, to R. W. Hegner, University of Michigan, $160, for assistance in the study of the history of the germ cells, especially in hermaphrodite animals in order to determine the visible changes that take place in their differentiation and the causes of these changes (continuation).

The following information has been received concerning earlier grants:

No. 183. A report has been received from C. G. Abbot, describing the successful operation of the apparatus constructed with this grant. This closes the record of this award.

No. 184. Papers have been published by P. W. Bridgman on work done with the aid of this grant as follows:

"Change of phase under pressure." Physical Review, n. s., VI, July and August, 1915.

"Polymorphic transformation of solids under pressure." Proceedings of the American Academy of Arts and Sciences, II, September, 1915.

This closes the record of this award.

The treasurer of the academy states, under date of April 7, 1916, that the Bache fund has on hand a cash income balance of $980.62, together with an invested income of $2,575.

EDWIN B. FROST,
Chairman.

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REPORT OF THE TRUSTEES OF THE WATSON FUND.

The balance of the income of the Watson fund, available for appropriation, on April 1, 1916, was $1,070.15. The undersigned accordingly recommend the following votes:

Resolved, That the sum of $500 from the income of the Watson fund be appropriated to Prof. John A. Miller, director of the Sproul Observatory, for measuring plates already taken for the determination of stellar parallaxes. (Grant No. 10.) This is a continuation of grant No. 10 awarded last year, A report of the work accomplished is inclosed.

Resolved, That the sum of $300 from the income of the Watson fund be appropriated to Prof. Herbert C. Wilson, director of the Goodsell Observatory, for measurements of the positions of asteroids on photographs already taken. (Grant No. 12.)

In each of these cases, material has already been collected whose preparation independently would involve a large expenditure. A relatively small sum will thus complete the work and secure the results for which the investigations were undertaken.

EDWARD C. PICKERING.
W. L. ELKIN.
E. B. FROST.

REPORT OF THE COMMITTEE ON THE HENRY DRAPER FUND.

Four members of the committee, without consulting the fifth member (Prof. Michelson), recommend that the Henry Draper gold medal be awarded to Prof. A. A. Michelson, of the University of Chicago, for his numerous and important contributions to spectroscopy and astronomical physics.

It is impossible in the brief space of this report even to enumerate Prof. Michelson's major services to science. These include the precise determination of the velocity of light; the well-known experiment (with Prof. Morley) on ether drift; the measurement of the absolute wave-length of light involved in his determination of the length of the standard meter; the measurement of tides in the body of the earth with new apparatus of extraordinary precision; and the invention of the interferometer, the echelon, and other instruments of prime importance to the student of light. He has also constructed a ruling machine yielding diffraction gratings of the longest size and the highest resolving power yet attained, and carried on a multiplicity of researches of wide range and fundamental significance.

The committee also recommends that a grant of $250 be made to Prof. Philip Fox, director of the Dearborn Observatory, of Northwestern University, Evanston, Ill., to apply toward the cost of a machine for measuring astronomical photographs.

Regarding previous grants from the Draper fund, the committee begs to report that the grant to Dr. C. G. Abbot has been expended for computer's services in an investigation which has established the variability of distribution of radiation along the sun's diameter. Grants to Messrs. Campbell, Mitchell, Stebbins, Schlesinger, respectively, for the construction of instruments or the prosecution of researches not yet completed.

GEORGE E. HALE,
Chairman.

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REPORT OF THE COMMITTEE ON THE J. LAWRENCE SMITH FUND.

The committee on the J. Lawrence Smith fund reports as follows:

No. 3. Edmund Otis Hovey, curator in the department of geology and invertebrate paleontology in the American Museum of Natural History, New York, received, in 1909, a grant of $400 to aid in the study of certain meteors. He has for some time been with an expedition to the Arctic regions, so that the work is not at the moment making progress.

No. 4. C. C. Trowbridge, professor of physics in Columbia University, New York, received in 1909 a grant of $400 in aid of his studies of the luminous trains which are produced by some meteors. A further grant of $1,000 in four annual installments was voted by the academy in 1912. Good progress has been made in the tabulation of all existing records of such luminous trains and in the preparation of illustrations of them, as well as in other directions. Owing to conditions in Europe, the last installment of $250, available a year ago, has not yet been called for.

No. 5. George P. Merrill, head curator in the department of geology in the United States National Museum, has received grants in 1910, 1911, and 1913, amounting to $800, to aid in verifying the occurrence in some meteors of certain rare elements. This work has been very successfully completed, abstracts of results obtained have been presented to the academy, and the final report forms pages 1–26 of the Memoirs of the Academy, Vol. 14, just issuing from the press, and closing the record of this grant.

No. 6. S. A. Mitchell, professor in the University of Virginia, University, Va., received in 1915 a grant of $500 to aid in securing observations of paths and of radiants of meteors and in computing orbits where observations are sufficient. Maps in aid of such observations have been placed at the service of volunteer observers, and nearly 5,000 observations of meteor paths have been secured. These observations, as well as a good number otherwise secured, have been discussed and have yielded some 139 parabolic orbits.

The committee is unanimous in recommending that a further grant of $300 be made to carry on this valuable work.

The J. Lawrence Smith fund now has a cash balance of income of $834.77, of which $250 is already appropriated, though not yet paid over. The cash income balance available is therefore $584.77. There is also an invested income balance of $1,532.50.

For the committee.

EDWARD W. MORLEY,
Chairman.

REPORT OF THE BOARD OF DIRECTORS OF THE BENJAMIN APTHORP GOULD FUND.

The directors of the Benjamin Apthorp Gould fund of the National Academy of Sciences have the honor to present the following report:

In 1914 a grant of $200 was made to Sidney D. Townley to assist him in making observations on variable stars at the Lick Observatory. Only half of the money was used during the year ending April, 1915, and the remainder was granted to him to be used for the same purpose in the year beginning April, 1915.

A grant of $200 was made to R. W. Wood for the purpose of assisting him in carrying on his work in the photography of celestial objects with monochromatic light.

A grant of $100 was made to A. Van Maanen for the purpose of securing assistance in reducing the proper motions of certain lists of stars.

A grant of $640 was made to Edwin B. Frost for the purpose of purchasing a machine for measuring parallax plates.

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A grant of $500 was made to A. H. Pfund in 1914, but was returned, together with the accumulated interest.

There is now a cash balance to the credit of the Gould fund of $113.92 and an invested income balance of $457.50.

F. R. MOULTON,
E. E. BARNARD,
R. S. WOODWARD,
Directors.

REPORT OF THE DIRECTORS OF THE WOLCOTT GIBBS FUND.

The directors of the Wolcott Gibbs fund for chemical research respectfully submit the following report for the year 1915 to 1916 to the National Academy of Sciences:

On April 29, 1915, President Ira Remsen resigned from the board to the great regret of his colleagues.

On May 18 Prof. T. W. Richards was elected to fill the vacancy caused by President Remsen's withdrawal.

Only one appropriation has been made from the income of the fund this year—a grant (No. 6) to Prof. Gregory P. Baxter, of Cambridge, of $300 to provide apparatus, especially of platinum and quartz, and materials for his researches on atomic weights and changes of volume during solution.

The unexpended income of the fund is $90.77.

Satisfactory reports have been received from holders of previous grants.

Grants 2 and 5: Prof. Mary E. Holmes has a paper in press on "The Electro-Deposition of Copper from the Ammoniacal Cyanide Electrotype." Progress has also been made in the study of the deposition of cadmium and its separation from other elements.

Grant 3: Prof. W. J. Hale has finished his work on the cyclopentadiopyridazine except for a few less important details. He hopes in June to have the paper ready for publication.

Grant 4: Prof. W. D. Harkins has determined the freezing point lowerings for 13 salts in aqueous solutions, 9 of which are cobaltammines; and has begun the study of mixtures of salts.

C. L. JACKSON,
EDGAR F. SMITH,
T. W. RICHARDS,
Directors.

APRIL 6, 1916.

REPORT OF THE COMMITTEE ON THE COMSTOCK FUND.

The committee on the Comstock fund begs to report that, according to the statement of the treasurer of the National Academy of Sciences, the total income from the fund now available is $1,661.32.

The next award will be made at the end of the five-year period specified in the bequest, i. e., at the annual meeting in April, 1918.

EDW. L. NICHOLS,
Chairman.

APRIL 18, 1916.

REPORT OF THE COMMITTEE ON THE MURRAY FUND.

The SECRETARY, NATIONAL ACADEMY OF SCIENCES.

SIR: The committee on the Sir John Murray fund has to report that the unusual expenses due to the designing and striking off of the Agassiz medal,

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as called for by the terms of the gift, has required all the early income. The committee deemed best not to touch the original fund, and the income from the fund was not sufficient to meet these expenses. All these expenses have now been met, but there is no cash balance and no invested income. This income has been applied to the payment of the amount advanced from the general fund, but from now on the interest from the fund will be applied as originally intended, for the striking off of the Agassiz medal and contributions to oceanography.

ARNOLD HAGUE,
Chairman.

BUSINESS FROM THE COUNCIL.

Recommendations adopted:

(*a*) That the annual dues for 1916 be $5.

(*b*) That the election of new members, foreign secretary, and two members of the council be held on Wednesday morning, April 19, 1916.

(*c*) That the treasurer be authorized to pay the annual subscription of 200 francs to the International Association of Academies. That the treasurer be directed to withhold this payment of dues to the International Association of Academies until advised by the foreign secretary that payment may properly be made.

(*d*) That the American Security & Trust Co., of Washington, D. C., and Spencer Trask & Co., of New York, be designated fiscal advisers of the academy for 1916 and 1917.

(*e*) That the time and place of the autumn meeting, 1916, be left to the president and home secretary with power.

(*f*) That the home secretary be requested to transmit the thanks of the academy to the Cosmos Club for the courtesies extended to the members of the academy during the annual meeting.

(*g*) That the members of the academy be permitted to choose the section with which they wish to be affiliated and that no one shall be a member of more than one section.

(*h*) That it is desirable that a section of engineering be developed which shall include men who have made original contributions to the science or art of engineering; that to this end the council suggests to the academy that the present section of physics and engineering be designated the section of physics, and that the council, under the authority granted by section 4, article 4, of the constitution, nominate to the academy, after inviting suggestions from the members of the academy, two or three engineers each year until such time as it shall seem advisable to establish a separate section of engineering, any engineer elected as the result of such nominations being in the meantime assigned to that one of the existing sections to which his work is most closely related.

(*i*) That the president be authorized to appoint a committee of three to investigate and present a written report at the business meeting on Wednesday, April 19, upon the bill H. R. 528, providing that the centigrade scale of temperature shall be the standard in United States publications and that the use of the Fahrenheit scale be discontinued after an appropriate interval.

(*j*) That in accordance with the request of the chairman of the Committee on Foreign Affairs of the House of Representatives a committee of the academy be appointed to prepare a report upon the joint resolution (H. J. Res. 99), "That the President be, and he is hereby, requested to ascertain the views of foreign Governments regarding the proposition to appoint an international commission to prepare a universal alphabet," and that the report be submitted to the President of the Academy, who in turn will transmit it to the chairman of the Com-

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mitee on Foreign Affairs of the House of Representatives, reporting his action in the matter at the next annual meeting of the academy.

(*k*) That following the suggestion of the chairman of the directorate of the Bache fund (Mr. Frost), the rule of rotation in the membership upon committees in charge of trust funds controlled by the academy be recommended for adoption by the self-perpetuating committees charged with similar duties, if found practicable.

REPORT OF THE BOARD OF EDITORS OF THE PROCEEDINGS.

The board of editors of the Proceedings reports to the academy that the 12 numbers of the Proceedings issued since its last annual report contain 157 original papers, the report of the annual and autumn meetings, notices of scientific memoirs, and the report of the Panama Canal committee. These numbers consist of 641 pages, an average of 53 pages per number and of about 4 pages per article. The papers are distributed among different sciences as follows: Mathematics, 17; astronomy, 37; physics, 11; chemistry, 12; geology, paleonotology, and mineralogy, 16; botany, 3; zoology, 13; genetics, 17; physiology, pathology, bacteriology, and biochemistry, 16; anthropology, 13; psychology, 2.

The universities or research laboratories that have contributed three or more papers are as follows: Carnegie Institution, 32 (divided as follows: Mount Wilson Solar Observatory, 22; nutrition laboratory, 4; marine biology, 3; terrestrial magnetism, 1; botanical research, 1; geophysical laboratory 1); University of California, 17; Harvard University, 16; Johns Hopkins University, 14; University of Chicago, 13; Yale University, 7; Rockefeller Institute, 7; Princeton University, 6; United States Geological Survey, 5; United States National Museum, 5; Station for Experimental Evolution, 4; University of Illinois, 3; American Museum of Natural History, 3.

The edition of the Proceedings was reduced from 3,000 to 2,200 copies with the issue of May, 1915, and it is to be further reduced to 1,700 copies with the issue of May, 1916, as the distribution of free copies in America is to be now entirely discontinued. At present about 900 copies are mailed to foreign exchanges and about 250 copies to members of the academy and other American subscribers.

The total expense incurred in connection with the Proceedings during the year 1915, representing approximately the cost of publication of the first volume, is shown by the report of the treasurer to be $4,300.67. Of this sum $2,977.37 was expended for printing and distributing, corresponding to a cost of $4.65 per page.

The board recommends that action be taken by the academy informing members and others presenting accounts of new researches at the academy meetings that they are expected to furnish to the home secretary at the time of the meeting a brief paper describing these researches in form suitable for publication in the Proceedings. The board also suggests that, in order to secure fuller circulation of the Proceedings in our universities, colleges, and research laboratories, members of the academy be requested to see that their own institutions subscribe to the Proceedings in case they have not already done so.

ARTHUR A. NOYES,
Chairman.

The report was accepted and the following minute adopted:

That members and others presenting accounts of their researches at meetings of the academy be expected to furnish the home secretary at the time of the meeting with a written description of such researches in form suitable for publication in the Proceedings.

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AMENDMENTS TO THE CONSTITUTION.

The following amendments to the constitution were reported from the council and considered by the academy in committee of the whole:

That article 3, section 1, line 3, of the constitution be amended by substituting the word "fourth" for "third" in the phrase "beginning on the third Monday in April."—(E. G. Conklin.)

Referred to the academy with favorable recommendation.

That the last sentence of section 5, article 4, of the constitution be stricken out.—(Ira Remsen.)

Referred to the academy with favorable recommendation.

ORGANIZATION OF THE SCIENTIFIC RESOURCES OF THE COUNTRY FOR NATIONAL SERVICE.

The following resolution recommended by the council was unanimously adopted:

Resolved, That the President of the Academy be requested to inform the President of the United States that in the event of a break in diplomatic relations with any other country the academy desires to place itself at the disposal of the Government for any service within its scope.

The council was empowered to organize the academy for the purpose of carrying out the resolution most effectively.

EXHIBITS AT MEETINGS.

The plan for an exhibit to be held in connection with the meetings from time to time as opportunity offers, and that such an exhibit be held at the autumn meeting if found practicable, was adopted.

TRUST FUNDS.

The suggestion of the chairman of the directorate of the Bache fund, proposing a form of report for grantees of research funds of the academy, was approved; and the home secretary was directed to bring this form to the attention of the chairmen of the trust funds of the academy and to supply copies for the use of the committees.

The form of application blank for aid from funds of the academy as now used by the directorate of the Bache fund was approved and the home secretary was authorized to provide a similar one for the use of the chairmen of the other funds of the academy.

AMENDMENT TO RULE IV.

The undersigned move that section 2 of Rule IV be amended by adding at the end of its second paragraph the following sentence:

"In order to secure an adequate number of nominations the chairman, when necessary, shall obtain by personal solicitation a fuller vote of his section or shall submit to the section a supplementary formal ballot"; and by substituting in the third paragraph for the words "this second ballot" the words "the formal ballots."

ARTHUR A. NOYES,
ARTHUR L. DAY.

Amendment adopted.

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REPORT OF THE COMMITTEE ON PALEONTOLOGIA UNIVERSALIS

At a meeting of the committee of the National Academy on the paleontologia universalis, held at the time of the recent New York meeting of the academy, it was voted to request the academy to discontinue this committee in view of the fact that present conditions do not encourage the undertaking of any international enterprise of this sort. As the academy had no business session subsequent to the action of this committee I transmit this action for your records.

JOHN M. CLARKE, *Chairman.*

DECEMBER 1, 1915.

The report of the committee was accepted and the committee discharged.

AMERICAN ACADEMY OF POLITICAL AND SOCIAL SCIENCE.

The invitation extended by the American Academy of Political and Social Science for the National Academy of Sciences to appoint delegates to the twentieth annual meeting of the American Academy, April 28 and 29, 1916, was accepted and three delegates were appointed: W. B. Scott, Edgar F. Smith, and Henry H. Donaldson.

PACIFIC EXPLORATION.

A committee of five was appointed to consider what can be done in Pacific exploration, to report at the next meeting. W. M. Davis, chairman; W. H. Dall, George E. Hale, E. G. Conklin, John F. Hayford.

JOSEPH A. HOLMES SAFETY ASSOCIATION.

Mr. David White presented a report as delegate of the National Academy of Sciences to the Joseph A. Holmes Safety Association. The report of progress was accepted and Mr. White was continued as the delegate of the academy.

BIOGRAPHICAL MEMOIRS.

Considering a plan to place the biographical memoirs of the academy where they would be of the greatest value, the following resolution was adopted:

That the academy favors the plan of distributing memoirs of deceased members to the members of national scientific societies corresponding to the sections of the academy to which the subject of the memoir belongs and requests the council to carry out the plan at its discretion.

COOPERATION WITH ENGINEERS.

The cooperation of engineers in the work of the academy for the national welfare was considered, and the following resolution adopted:

The council recommends to the academy the appointment of a committee to discuss possible plans of cooperation with a committee of engineers.

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The committee on the part of the academy was constituted as follows: George E. Hale, chairman; Robert S. Woodward, M. I. Pupin, C. R. Van Hise, C. D. Walcott, Elihu Thomson, John F. Hayford, E. L. Nichols, E. B. Rosa, and J. S. Ames.

CENTIGRADE AND FAHRENHEIT SCALES.

Mr. C. G. Abbot, chairman of the committee appointed to report on the bill (H. R. 528) substituting the centigrade for the Fahrenheit thermometer scale in Government publications presented the following report, which was accepted:

Your committee for the consideration of bill H. R. 528, consisting of Messrs. C. G. Abbot, S. W. Stratton, and C. F. Marvin, unanimously reports the following resolution and moves its adoption:

The National Academy of Sciences shares the desire of scientific men in general for international and world-wide uniformity in units of measurement of all kinds, and with this object in view it favors the introduction of the centigrade scale of temperature, and units of the metric system generally, as standards in the publications of the United States Government.

It must be recognized that considerable initial expense must be incurred by the United States Weather Bureau in changing its apparatus to conform to the proposed act. Furthermore, on account of the more open scale of the centigrade system that bureau will be subject to a continued increased cost of publication, owing to the necessity of printing the first decimal place in order to maintain the present accuracy. The use of negative temperatures and minus signs entails greater liability to errors, and more clerical labor would be required in checking the accuracy of the reports of cooperative observers of the Weather Bureau, and in computing monthly and other mean temperatures.

Notwithstanding the foregoing, the academy is in favor of legislation to make the centigrade scale of temperatures the standard in publications of the United States Government, and funds should be made available by Congress to accomplish the desired result.

The academy favors bill H. R. 528, "To discontinue the use of the Fahrenheit thermometer scale in Government publications," but recommends that it be amended by the addition of the following:

"SEC. 4. When in the publication of tables containing several meteorological and climatic elements, the use of data in centigrade temperatures leads to manifest incongruities, the Chief of the Weather Bureau is directed to publish related data in such units as are necessary to make the tables homogeneous and to secure international uniformity as far as practicable.

"SEC. 5. Nothing in this act shall prevent the use of the absolute centigrade scale of temperature in publications of the Government."

ELECTION OF FOREIGN SECRETARY.

Mr. George E. Hale was elected foreign secretary for a period of six years to succeed himself.

ELECTION OF TWO MEMBERS OF THE COUNCIL.

Mr. Russell H. Chittenden was elected to the council to succeed himself, and Mr. M. I. Pupin was elected for a period of three years.

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ELECTION OF MEMBERS.

The following new members were elected:

Gilbert Ames Bliss, mathematician, University of Chicago, Chicago, Ill.

Frank Schlesinger, astronomer, University of Pittsburgh, Pittsburgh, Pa.

Gregory Paul Baxter, chemist, Harvard University, Cambridge, Mass.

Marston Taylor Bogert, chemist, Columbia University, New York City.

Leland Ossian Howard, entomologist, United States Department of Agriculture, Washington, D. C.

Alfred Goldsborough Mayer, zoologist, Carnegie Institution, Tortugas, Fla.

Raymond Pearl, genetics, Maine Agricultural Experiment Station, Orono, Me.

Phoebus Aaron Theodor Levene, chemist, Rockefeller Institute of Medical Research, New York City.

Otto Folin, chemist, Harvard Medical School, Boston, Mass.

AUTUMN MEETING.

The president stated that the invitation of the members of the academy in Boston and vicinity to hold the autumn meeting in Boston on November 13, 14, 15, 1916, had been accepted.

COMMITTEE ANNOUNCEMENTS.

The president announced the following appointments to fill committee vacancies:

On program: J. McK. Cattell, 1919, to succeed himself.

TRUST FUNDS.

Henry Draper fund: Charles G. Abbot, 1921, in place of J. Trowbridge; W. W. Campbell, to serve as chairman.

J. Lawrence Smith fund: R. W. Wood, 1921, to succeed Ira Remsen.

Comstock fund: R. A. Millikan, 1921, to succeed Henry Crew.

Murray fund: W. M. Davis, 1919, in place of Arnold Hague; W. H. Dall, to be chairman.

Marcellus Hartley fund: W. H. Welch, term expires and vacancy not filled. Committee to consist of the remaining six members, two to retire each year. Assignments: G. F. Becker and W. F. Hillebrand, 1919; H. F. Osborn and M. I. Pupin, 1918; A. G. Webster and Theobald Smith, 1917.

Marsh fund.—E. H. Moore, 1919; C. Schuchert, 1918; E. S. Dana, 1917.

Watson fund: G. C. Comstock to succeed E. C. Pickering, resigned. E. B. Frost designated chairman of the trustees of the Watson fund.

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COMMITTEES.

Local committee, autumn meeting.—William M. Davis, chairman; E. C. Pickering, W. T. Councilman, George H. Parker, Arthur A. Noyes.

Pacific exploration.—W. M. Davis, chairman; George E. Hale, W. H. Dall, E. G. Conklin, John F. Hayford.

Cooperation with the engineering societies.—George E. Hale, chairman; R. S. Woodward, M. I. Pupin, C. R. Van Hise, C. D. Walcott, Elihu Thomson, John F. Hayford, E. L. Nichols, E. B. Rosa, J. S. Ames.

Universal alphabet.—J. McK. Cattell, chairman; A. Graham Bell, John Dewey, Waldemar Lindgren, Franz Boas.

Centigrade scale.—C. G. Abbot, chairman; C. F. Marvin, S. W. Stratton.

PRESENTATION OF MEDALS.

At the annual dinner of the academy, held at the Hotel Raleigh on April 18, 1916, the following medals were awarded:

WATSON MEDAL.

The Watson medal and honorarium provided by the Watson fund: To Armin Otto Leuschner for the skill and ability shown in supervising the preparation of tables of the Watson asteroids, involving original methods, and leading to results of value to celestial mechanics.

MEDAL FOR EMINENCE IN THE APPLICATION OF SCIENCE TO THE PUBLIC WELFARE.

The medal for eminence in the application of science to the public welfare provided by the Marcellus Hartley fund: To Cleveland Abbe for distinguished public service in establishing and organizing the Weather Service of the United States.

To Gifford Pinchot for distinguished public service in organizing and directing the movement for the systematic conservation of the natural resources of the United States.

SCIENTIFIC SESSIONS.

Meeting of April 17–19, 1916.

Monday, April 17.

MORNING SESSION.

S. J. MELTZER: On permeability of endothelia. (10 minutes.)

I. S. KLEINER and S. J. MELTZER: The influence of morphin upon the elimination of intravenously injected dextrose. (10 minutes.)

JACQUES LOEB: The sex of a parthenogenetic frog. (10 minutes.)

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SIMON FLEXNER: Finer mechanisms of protection from infection. (10 minutes.)

EDMUND B. WILSON: The distribution of the chondrisomes to the spermatozoa in scorpions. (15 minutes.)

VICTOR C. VAUGHAN: Further studies of the protein poison. (10 minutes.)

SYMPOSIUM ON THE EXPLORATION OF THE PACIFIC.

Arranged by W. M. Davis.

(By invitation of the program committee.)

W. M. DAVIS: On exploration of the Pacific. (20 minutes.)

J. F. HAYFORD: The importance of gravity observations at sea in the Pacific. (15 minutes.)

L. J. BRIGGS, President of the Philosophical Society of Washington: A new method of determining gravity at sea. (10 minutes.)

C. SCHUCHERT: The problem of continental fracturing and diastrophism in Oceanica. (12 minutes.)

J. P. IDDINGS: Petrological problems in the Pacific. (15 minutes.)

AFTERNOON SESSION.

ARTHUR KEITH (introduced by George F. Becker): A new form of metamorphism. (10 minutes.)

J. P. IDDINGS and E. W. MORLEY: Contributions to the petrology of Japan, Philippine Islands and the Dutch Indies. (10 minutes.)

SYMPOSIUM ON THE EXPLORATION OF THE PACIFIC.

(Continued from the morning session.)

G. W. LITTLEHALES, hydrographic engineer United States Hydrographic Office: The extent of knowledge of the oceanography of the Pacific. (15 minutes.)

C. F. MARVIN, Chief of the United States Weather Bureau: Marine meteorology and the general circulation of the atmosphere. (15 minutes.)

WM. H. DALL: On the distribution of Pacific invertebrates. (15 minutes.)

H. A. PILSBRY, Academy of Natural Sciences of Philadelphia: Land mollusca of the Pacific. (15 minutes.)

W. G. FARLOW: Marine algae of the Pacific. (15 minutes.)

D. H. CAMPBELL: Problems of the Pacific floras. (15 minutes.)

J. W. FEWKES: The Pacific as a field for anthropological investigation. (15 minutes.)

PAPERS OF THE REGULAR PROGRAM.

CHARLES R. STOCKARD, professor of anatomy, Cornell University Medical College, New York City: Hereditary transmission of defects resulting from alcoholism. (30 minutes.) (By invitation of the program committee.)

W. B. CANNON: Recent observations on the activity of some glands of internal secretion. (30 minutes.)

H. H. DONALDSON: Studies in the water content of the nervous system. (20 minutes.)

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EVENING SESSION.

First William Ellery Hale lecture, by Henry Fairfield Osborn, president of the American Museum of Natural History. Subject: The origin and evolution of life on the earth. (Illustrated.)

The lecture was followed by a conversazione in the art gallery of the museum.

Tuesday, April 18.

MORNING SESSION.

GEORGE E. HALE: Some recent results of solar research. (10 minutes.)

CHARLES E. ST. JOHN (introduced by G. E. Hale): An investigation of the suggested mutual repulsion of Fraunhofer lines. (10 minutes.)

ARTHUR S. KING (introduced by G. E. Hale): Anomalous dispersion phenomena in electric furnace spectra. (10 minutes.)

WALTER S. ADAMS (introduced by G. E. Hale): Illustrations of the new spectroscopic method of measuring stellar distances. (10 minutes.)

HARLOW SHAPLEY (introduced by G. E. Hale): Some results with the new 10-inch photographic telescope. (10 minutes.)

C. G. ABBOTT and L. B. ALDRICH: The pyranometer, an instrument for the measurement of sky radiation. (10 minutes.)

G. C. COMSTOCK: Invisible companions of binary stars. (10 minutes.)

EDWIN H. HALL: Theory of electric conduction in metals. (10 minutes.)

F. R. MOULTON: The evolution of the stars. (30 minutes.)

A. O. LEUSCHNER, Watson medallist: The minor planets discovered by James C. Watson. (20 minutes.)

AFTERNOON SESSION.

WM. H. DALL: Biography of Prof. Theodore Nicholas Gill (by title).

W. W. CAMPBELL: Biography of Prof. Edward Singleton Holden (by title).

W. W. CAMPBELL: Biography of Prof. Simon Newcomb (by title).

Report of the work of the committee upon the Panama Canal slides, by CHARLES R. VAN HISE, chairman. (30 minutes.)

H. FIELDING REID: The mechanics of the Panama slides. (20 minutes.)

THEODORE LYMAN, director Jefferson Physical Laboratory, Harvard University: The present state of knowledge of the extreme ultra-violet. (30 minutes.) (By invitation of the program committee.)

ROBERT A. MILLIKAN: A redetermination of e and N. (20 minutes.)

CARL L. ALSBERG, Chief of the Bureau of Chemistry, United States Department of Agriculture: The relation of investigational work to the enforcement of the food and drugs act. (30 minutes.) (By invitation of the program committee.)

J. WALTER FEWKES: Recent exploration of the Mesa Verde National Park, Colorado. (20 minutes.)

ERWIN F. SMITH: Further evidence on the nature of crown gall and cancer and that cancer in plants offers strong presumptive evidence both of the parasitic origin and of the essential unity of the various forms of cancer in man and animals. (60 minutes.)

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Wednesday, April 19.

AFTERNOON SESSION.

Second William Ellery Hale lecture, by Henry Fairfield Osborn, president of the American Museum of Natural History. Subject: The origin and evolution of life on the earth. (Illustrated.)

AUTUMN MEETING.

The autumn meeting of the academy was held at the Massachusetts Institute of Technology, Cambridge, Mass., on November 13, 14, 15, 1916.

Seventy-one members were present as follows: Abbot (C. G.), Abbot (H. L.), Barus, Baxter, Becker, Boas, Bogert, Boltwood, Bumstead, Cannon, Castle, Cattell, Chittenden, Clark (W. B.), Clarke (J. M.), Comstock, Conklin, Councilman, Crafts, Crew, Cross, Davenport, Davis, Day, Farlow, Fewkes, Folin, Goodale, Hale, Hall, Harper, Harrison, Hayford, Holmes, Howard, Howell, Iddings, Jackson, Leuschner, Lewis, Lindgren, Lusk, Mall, Mark, Mayer, Meltzer, Mendel, Michelson, Morley, Morse, Noyes, Osborn, Osborne, Parker, Pearl, Pickering, Prudden, Reid, Richards, Rosa, Scott, Story, Thomson, Van Hise, Walcott, Webster, Welch, Wheeler, White (David), Wilson, Wood (R. W.).

BUSINESS SESSION.

The home secretary made the following announcements:

DEATHS SINCE THE ANNUAL MEETING.

Members.—Cleveland Abbe, elected 1879, died October 28, 1916; Josiah Royce, elected 1906, died September 14, 1916.

Foreign Associate.—Sir William Ramsay, elected 1904, died July 24, 1916.

PUBLICATIONS ISSUED SINCE THE LAST ANNUAL MEETING.

Proceedings, volume 2, numbers 5–11.

Memoirs, volume 14, first memoir: George P. Merrill: Report on researches on the chemical and mineralogical composition of meteorites, with especial reference to their minor constituents.

Biographical Memoirs: George William Hill, by Ernest W. Brown; Theodore N. Gill, by William H. Dall.

CHANGES IN THE EDITORIAL BOARD OF THE PROCEEDINGS.

Raymond Pearl, chairman, in place of A. A. Noyes.

Retiring December 1, 1916: W. B. Cannon, J. McK. Cattell, J. M. Coulter, Simon Flexner, R. G. Harrison.

Appointed in 1916: A. G. Mayer, H. H. Donaldson, Graham Lusk, R. A. Harper, A. A. Noyes.

E. B. Wilson, managing editor, reappointed.

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COMMITTEE ANNOUNCEMENTS.

Auditing Committee.—William H. Dall, F. W. Clarke, Arthur L. Day.

Committee on the Organization of the Scientific Resources of the Country for National Service.—G. E. Hale, chairman; E. G. Conklin, Simon Flexner, R. A. Millikan, A. A. Noyes.

Joint Committee with American Chemical Society on Synthetic Organic Chemistry.—M. T. Bogert, chairman.

Committee on Nitric Acid Supply.—Arthur A. Noyes, chairman; Gano Dunn, Warren K. Lewis,[1] Theodore W. Richards, Leo H. Baekeland,[1] Charles N. Herty,[1] Michael I. Pupin, Elihu Thomson, Willis R. Whitney.[1]

NATIONAL RESEARCH COUNCIL.

The president announced that he had forwarded a preliminary report on the National Research Council to the President of the United States.

NEW MEMBERS.

The following new members were presented to the academy: Marston Bogert, L. O. Howard, A. G. Mayer, Raymond Pearl.

MARSH FUND.

The treasurer reported that notice had been received from the attorneys for Mr. W. W. Farnam, the executor of the estate of Othniel C. Marsh, that he had filed in the New Haven probate court a supplemental account as executor which showed a balance of interest due the academy of $6,921.84.

SECTION OF ENGINEERING.

The following resolution presented by the council and adopted at the business session of the academy on April 17, 1916, was considered:

That the council express to the academy the opinion that it is desirable that a section of engineering be developed which shall include men who have made original contributions to the science or art of engineering; that to this end the council suggests to the academy that the present section of physics and engineering be designated the section of physics, and that the council, under the authority granted by section 4, article 4, of the constitution, nominate to the academy, after inviting suggestions from the members of the academy, two or three engineers each year until such time as it shall seem advisable to establish a separate section of engineering, any engineers elected as the result of such nominations being in the meantime assigned to that one of the existing sections to which their work is most closely related.

The home secretary was authorized to send a copy of the above resolution to each member.

[1] Named by the American Chemical Society.

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AMENDMENTS TO THE CONSTITUTION.

The following amendments to the constitution, reported from the council and returned to the academy from the committee of the whole with favorable recommendation, were considered:

That article 3, section 1, line 3, of the constitution be amended by substituting the word "fourth" for "third" in the phrase "beginning on the third Monday in April."

Amendment lost.

That the last sentence of section 5, article 4, of the constitution be stricken out.

Amendment adopted.

The following new amendment to the constitution was offered:

Moved: That Article III, section 1, be amended by striking out the words "beginning on the third Monday in April" and inserting after the word "meeting" in the third line the word "both" and adding at the end of the section the words "*Provided*, That the annual meeting shall be held in April" so as to read:

"ARTICLE III, SECTION 1. The academy shall hold one stated meeting in each year, called the annual meeting, in the city of Washington, and another, called the autumn meeting, both to be held at such place and time as the council shall determine, provided that the annual meeting shall be held in April."

CHARLES R. VAN HISE.
CHARLES D. WALCOTT.

Amendment referred to the council.

REPORT OF THE NATIONAL RESEARCH COUNCIL.

On April 19, 1916, at the closing session of the annual meeting, the academy voted unanimously to offer its services to the President of the United States in the interest of national preparedness. The council of the academy was authorized to execute the work in the event of the President's acceptance.

On April 26 the President of the Academy, accompanied by Messrs. Conklin, Hale, Walcott, and Woodward, was received at the White House by the President of the United States. In presenting the resolution adopted at the annual meeting, it was suggested that the academy might advantageously organize the scientific resources of educational and research institutions in the interest of national security and welfare. The President accepted this offer, and requested the academy to proceed at once to carry it into effect.

Immediately following this visit, the President of the Academy, in harmony with resolutions adopted by the council on April 19, appointed the following organizing committee: Messrs. Edwin G. Conklin, Simon Flexner, Robert A. Millikan, Arthur A. Noyes, and George E. Hale (chairman). This committee, after obtaining assurances of cooperation from members of the Cabinet, national scientific and engineering societies, the committee of physicians, scientific bureaus of the Government, research foundations, educational institutions, industrial research laboratories, and many leading investigators, and after organizing a committee on nitrate supply (A. A. Noyes, chairman) at the request of the Secretary of War, prepared a general plan of procedure, which was presented to the council of the academy on June 19.

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It was recognized from the outset that the work to be undertaken should not be confined to the promotion of researches bearing directly upon military problems, but that true preparedness would best result from the encouragement of every form of investigation, whether for military and industrial application or for the advancement of knowledge without regard to its immediate practical bearing. The scheme of organization must be broad enough to secure the cooperation of all important agencies in accomplishing this result.

The plan submitted, which has been published in full in the Proceedings of the academy (vol. 2, p. 508), called for the formation of a National Research Council, the purpose of which shall be to bring into cooperation governmental, educational, industrial, and other research organizations with the object of encouraging the investigation of natural phenomena, the increased use of scientific research in the development of American industries, the employment of scientific methods in strengthening the national defense, and such other applications of science as will promote the national security and welfare.

It was also recommended that the council be composed of leading American investigators and engineers, representing the Army, Navy, Smithsonian Institution, and various scientific bureaus of the Government, educational institutions and research endowments, and the research divisions of industrial and manufacturing establishments.

The council of the academy voted to accept the proposals of the organizing committee, and instructed it to proceed with the formation of the National Research Council in accordance with the plan recommended by the committee.

The indorsement of the President of the United States and his willingness to appoint Government representatives was expressed in the following letter to the President of the Academy:

"WASHINGTON, D. C., *July 24, 1916.*

"DR. WILLIAM H. WELCH,

"*President of the National Academy of Sciences, Baltimore, Md.*

"MY DEAR DR. WELCH: I want to tell you with what gratification I have received the preliminary report of the National Research Council, which was formed at my request under the National Academy of Sciences. The outline of work there set forth and the evidences of remarkable progress toward the accomplishment of the object of the council are indeed gratifying. May I not take this occasion to say that the departments of the Government are ready to cooperate in every way that may be required, and that the heads of the departments most immediately concerned are now, at my request, actively engaged in considering the best methods of cooperation?

"Representatives of Government bureaus will be appointed as members of the Research Council as the council desires.

"Cordially and sincerely yours,

"WOODROW WILSON."

On August 5, with the assent of the heads of the several executive departments, the President appointed certain representatives of the Army and Navy and of various scientific bureaus of the Government as members of the National Research Council, with the understanding that others would be appointed as the development of the work might require. The remaining members of the council were appointed by the President of the National Academy, after consultation with the presidents of various national scientific and engineering societies (enumerated in the Proceedings, 607, loc. cit.).

The President of the Academy and the chairman of the organizing committee then sailed for Europe for the purpose of studying the organization and applications of science in field and laboratory under war conditions. The informa-

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tion thus acquired is being utilized in the work of the council, which held its first meeting on September 20.

As the minutes of this meeting and of the subsequent meetings of the executive committee have been fully reported in the Proceedings, it is unnecessary to give them here. One instance of the cordial cooperation experienced on every hand must be cited, however, because of its fundamental significance in the organization of the council.

At its annual meeting on June 21 the Engineering Foundation of New York, which is conducted under the auspices of the four great national engineering societies, adopted the following resolutions:

"Whereas, the National Academy of Sciences of the United States of America has taken the initiative in bringing into cooperation existing governmental, educational, industrial, and other research organizations, with the object of encouraging the investigation of natural phenomena, the application of scientific principles in American industries, the employment of science in the national defense, and such other objects as will promote the national welfare, and

"Whereas, these objects are among the objects for which the Engineering Foundation was created; now, therefore, be it

"*Resolved*, That the Engineering Foundation hereby registers its approval of the coordination and federation of the research agencies of the country undertaken by the National Academy of Sciences and expresses its willingness to join with and assist the National Academy in accomplishing the above federation."

The foundation also voted to devote its entire income for the current year (including a special gift of $5,000 for this purpose from its founder, Mr. Ambrose Swasey) toward the expenses of organization, to give the services of its secretary, Dr. Cary T. Hutchinson, and to provide a New York office for the council in the Engineering Societies' Building.

Similar resolutions of indorsement and cooperation have been adopted by the American Philosophical Society, the Marine Biological Laboratory at Woods Hole, the American Physical Society, the American Institute of Consulting Engineers, the Franklin Institute, the Zoological Society of America, the American Society of Naturalists, the Geological Society of America, the Association of American Geographers, the Association of American Anatomists, and many other societies and institutions.

As President Wilson especially requested the academy to secure the cooperation and joint effort of the various research agencies of the country, the participation of the Committee of One Hundred on Scientific Research of the American Association for the Advancement of Science was especially desired. A joint committee, representing the American association and the National Research Council, was appointed to consider plans of cooperation. It presented a report at the meeting of the Committee of One Hundred, held in New York on December 26, 1916, which then

"*Resolved*, That the Committee of One Hundred on Scientific Research of the American Association for the Advancement of Science cooperate with the National Research Council in those research movements in which both organizations are interested; and especially, in order to avoid duplication of effort that might arise from individual action of the two groups of committees which have already been appointed in the different sciences, that the Committee of One Hundred of the Association cooperate with the National Academy of Sciences and the national scientific societies in the formation of single committees in the various branches of science.

88121°—S. Doc. 707, 64-2——3

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That in order to effect the cooperation provided by the preceding vote the Committee of One Hundred on research designate through its chairman members of the Association to serve as members of the research committees of the National Research Council devoted to the various branches of science. with the understanding that these committees shall consist of members designated in equal or approximately equal numbers by the association, the National Academy of Sciences, and the national scientific society representing the branch of research involved.

After discussion this motion was carried.

The officers and members of the National Research Council are:

OFFICERS.

Chairman, George E. Hale.
First vice chairman, Charles D. Walcott.
Second vice chairman, Gano Dunn.
Chairman of executive committee, J. J. Carty.
Secretary, Cary T. Hutchinson.

EXECUTIVE COMMITTEE.

1. William H. Welch,[1] President, National Academy of Sciences.
2. George E. Hale,[1] Director, Mount Wilson Solar Observatory.
3. C. D. Walcott,[1] Secretary, Smithsonian Institution.
4. Gano Dunn,[1] President, J. G. White Engineering Corporation.
5. J. J. Carty, Chief Engineer, American Telephone & Telegraph Co.
6. Russell H. Chittenden, Director, Sheffield Scientific School, Yale University.
7. Edwin G. Conklin, Professor of Zoology, Princeton University.
8. Robert A. Millikan, Professor of Physics, University of Chicago.
9. Arthur A. Noyes, Professor of Physical Chemistry, Massachusetts Institute of Technology.
10. Raymond Pearl, Biologist, Maine Agricultural Experiment Station.
11. M. I. Pupin, Professor of Electromechanics, Columbia University.
12. S. W. Stratton, Director, Bureau of Standards.
13. Victor C. Vaughan, Director, Medical Research Laboratory, University of Michigan.

MEMBERS.

Leo H. Baekeland, Past President, American Electrochemical Society.
Marston T. Bogert, Professor of Organic Chemistry, Columbia University.
John A. Brashear, Past President, American Society of Mechanical Engineers.
W. B. Cannon, Harvard Medical School.
John J. Carty, Chief Engineer, American Telephone & Telegraph Co.
Russell H. Chittenden, Director, Sheffield Scientific School.
John M. Clarke, State Geologist, Albany, N. Y.
Howard E. Coffin, Member Advisory Commission to Council of National Defense.
Edwin G. Conklin, Professor of Zoology, Princeton University.
John M. Coulter, Professor of Botany, University of Chicago.
William Crozier, Chief of Ordnance, United States Army.
W. M. Davis, Harvard University.
Gano Dunn, President, J. G. White Engineering Corporation.
Simon Flexner, Director, Rockefeller Medical Institute.
James D. Gatewood, Medical Director, Naval Medical School.

[1] Members ex officio.

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William C. Gorgas, Surgeon General, United States Army.
W. F. M. Goss, Dean of Engineering, University of Illinois.
Robert S. Griffin, Engineer in Chief, United States Navy.
George E. Hale, Director, Mount Wilson Solar Observatory.
Clemens Herschel, President, American Society of Civil Engineers.
William H. Holmes, Curator, United States National Museum.
W. W. Keen, President, American Philosophical Society.
Van H. Manning, Director, Bureau of Mines.
Franklin H. Martin, Member Advisory Commission to Council of National Defense.
Charles F. Marvin, Chief, United States Weather Bureau.
A. A. Michelson, Director, Ryerson Physical Laboratory, University of Chicago.
Robert A. Millikan, Professor of Physics, University of Chicago.
Arthur A. Noyes, Director, Research Laboratory of Physical Chemistry, Massachusetts Institute of Technology.
Raymond Pearl, Biologist, Maine Agricultural Experiment Station.
E. C. Pickering, Director, Harvard College Observatory.
Michael I. Pupin, Professor of Electromechanics, Columbia University.
Charles F. Rand, President, United Engineering Society.
Theodore W. Richards, Director, Wolcott Gibbs Memorial Laboratory, Harvard University.
C. E. Skinner, Engineer of Research Division, Westinghouse E. & M. Co.
George O. Squier, Chief of Aviation, United States Army.
S. W. Stratton, Director, Bureau of Standards.
Ambrose Swasey, Past President, American Society of Mechanical Engineers.
David W. Taylor, Chief Constructor, United States Navy.
Elihu Thomson, Past President, American Institute of Electrical Engineers.
C. R. Van Hise, President, American Association for the Advancement of Science.
Victor C. Vaughan, Director, Medical Research Laboratory, University of Michigan.
Charles D. Walcott, Secretary, Smithsonian Institution.
William H. Welch, President, National Academy of Sciences.
W. R. Whitney, Director, Research Laboratory, General Electric Co.

The principal committees hitherto established by the Research Council are as follows:

I. Military committee (for governmental research requirements):
Charles D. Walcott, chairman, Secretary, Smithsonian Institution.
S. W. Stratton, secretary, Director, Bureau of Standards.
From the Army—
William C. Gorgas, Surgeon General, United States Army.
William Crozier, Chief of Ordnance, United States Army.
George O. Squier, Chief of Aviation, United States Army.
From the Navy—
David W. Taylor, Chief Constructor, United States Navy.
Robert S. Griffin, Engineer in Chief, United States Navy.
James D. Gatewood, Medical Director, Naval Medical School.
Charles F. Marvin, Chief, Weather Bureau.
Van H. Manning, Director, Bureau of Mines.
Howard E. Coffin, of Council of National Defense.

II. Research in educational institutions: George E. Hale, chairman.
III. Promotion of industrial research: J. J. Carty, chairman.
IV. Census of research: S. W. Stratton, chairman.
V. Chemistry: Marston T. Bogert, chairman.
VI. Physics: R. A. Millikan, chairman.

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VII. Astronomy: E. C. Pickering, chairman.
VIII. Botany: J. M. Coulter, chairman.
IX. Zoology: E. G. Conklin, chairman.
X. Medicine and Hygiene: Victor C. Vaughan, chairman.
XI. Agriculture: Raymond Pearl, chairman.
XII. Physiology: W. B. Cannon, chairman.
XIII. Geography: W. M. Davis, chairman.
XIV. Geology: John M. Clarke, chairman.
XV. Anthropology: Wm. H. Holmes, chairman.
XVI. Aeronautics: Charles D. Walcott, chairman.
XVII. Nitrate supply: Arthur A. Noyes, chairman.

The offices of the council are at the Smithsonian Institution, and with the Engineering Foundation, Engineering Societies' Building, New York City.

GEORGE E. HALE, *Chairman.*

REPORT OF THE COMMITTEE ON PANAMA CANAL SLIDES.

Mr. Van Hise, chairman of the committee appointed at the request of the President of the United States to investigate the landslides which have interfered with the use of the Panama Canal, offered an informal forecast of the committee's report.

Moved:

That the printing of the final report be referred to the council with power.

Adopted.

MINUTES.

The home secretary was directed to send copies of the minutes of each business session of the academy to all members of the academy for approval and correction.

PROCEEDINGS.

Moved:

That papers by nonmembers appearing in the Proceedings be announced as "communicated by" some member.

Adopted.

J. LAWRENCE SMITH FUND.

The following recommendation of the chairman of the committee on the J. Lawrence Smith fund was adopted:

That a grant of $500 be made from the J. Lawrence Smith fund to Mr. George Perkins Merrill to further aid his studies of rare meteorites.

MARSH FUND.

The chairman of the committee on the Marsh fund made written recommendation:

That a grant of $400 be made from the Marsh fund to Mr. John M. Clarke for a study of mutualism, symbiosis, and dependent life among animals of geologic time.

Adopted.

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COMMITTEE ON THE MEDAL FOR EMINENCE IN THE APPLICATION OF SCIENCE TO THE PUBLIC WELFARE.

Mr. Becker, chairman of the committee on the medal for eminence in the application of science to the public welfare presented the following report:

The committee recommends that the public welfare medal be bestowed upon Dr. S. W. Stratton, for his services in introducing standards into the practice of technologists in the United States, at the stated session in April, 1917.

GEORGE F. BECKER.

NOVEMBER 6, 1916.

The recommendation was adopted.

BIOGRAPHICAL MEMOIRS.

A committee on the preparation of biographical memoirs was authorized and the following committee appointed: Mr. Davenport, chairman; Mr. Comstock, Mr. Mayer, the home secretary (ex officio).

The president announced the assignment of the biography of Mr. Cleveland Abbe to Mr. W. J. Humphreys, and that of Mr. Josiah Royce to Mr. John Dewey.

COMMITTEE ON SYNTHETIC ORGANIC CHEMISTRY.

Mr. Bogert reported as chairman, from the committee on synthetic organic chemistry, that the activities of the committee had now been merged with the National Research Council, and asked that the committee be discharged. The report was accepted and the committee discharged.

SCIENTIFIC SESSIONS.

MONDAY, NOVEMBER 13.

AFTERNOON SESSION.

Welcome by President MACLAURIN, of the Massachusetts Institute of Technology.

RAYMOND PEARL, Maine Agricultural Experiment Station. Some effects of the continued administration of alcohol to the domestic fowl, with special reference to the progeny. (20 minutes, lantern.)

EDWARD S. MORSE, Salem, Mass. Protoconch of Solemya. (10 minutes.)

ALFRED G. MAYER, Marine Laboratory, Carnegie Institution. Further studies of nerve conduction. (10 minutes, lantern.)

E. G. CONKLIN, Princeton University. The share of egg and sperm in heredity. (10 minutes, lantern.)

JACQUES LOEB, Rockefeller Institute. Diffusion and secretion. (12 minutes.)

LAFAYETTE B. MENDEL and S. E. JUDSON, Yale University. Some interrelations between diet, growth, and the chemical composition of the body. (12 minutes.)

ALESSANDRO FABBRI (introduced by A. G. MAYER). Micro-cinematographs of marine and fresh water organisms. (15 minutes, lantern.)

HENRY L. ABBOT, Cambridge, Mass. *Hydrology of the Isthmus of Panama.

JOHN M. CLARKE, State Museum, Albany. *The strand and the undertow.

* Papers marked with an asterisk were presented by title.

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W. LINDGREN, Massachusetts Institute of Technology. *Notes on the deposition of quartz, chalcedony, and opal.

W. M. DAVIS, Harvard University. *Sublacustrine glacial erosion in Montana.

EVENING SESSION.

President W. H. WELCH, Johns Hopkins University. The formation of the National Research Council at the request of the President of the United States. (15 minutes.)

Dr. S. W. STRATTON, Director of the National Bureau of Standards, Washington. Target practice in the Navy and some of the research problems involved; illustrated with moving pictures. (45 minutes.)

Reception and scientific exhibit in the general library from 9.15 to 10.30. (See list of exhibits below.)

TUESDAY, NOVEMBER 14.

MORNING SESSION.

EDWIN H. HALL, Harvard University. Electric conduction in metals. (20 minutes, lantern.)

EDWARD B. ROSA, National Bureau of Standards. The silver voltameter as an international standard. (15 minutes.)

R. W. WOOD, Johns Hopkins University. One-dimensional gases and the reflection of molecules. Series in resonance spectra. (10 minutes, lantern.)

ELIHU THOMSON, Swampscott, Mass. Inferences concerning auroras. (20 minutes.)

A. A. MICHELSON, University of Chicago. Report of progress in experiments for measuring the rigidity of the earth. (10 minutes.) The laws of elastico-viscous flow. (10 minutes.)

C. G. ABBOT, Smithsonian Institution. On the preservation of knowledge. (5 minutes.)

FRANZ BOAS, Columbia University. Further evidence regarding the instability of human types. (20 minutes.)

Ross G. HARRISON, Yale University. Transplantation of limbs. (20 minutes, lantern.)

CHAS. B. DAVENPORT, station for experimental evolution, Carnegie Institution. Heredity of stature. (20 minutes, lantern.)

F. R. MOULTON, Chicago University. *On analytic functions of infinitely many variables.

HENRY S. WHITE, Vassar College, F. N. COLE and LOUISE D. CUMMINGS. *Enumeration of all triad systems on fifteen elements.

A. G. WEBSTER, Clark University. *Practical tests of a new phonotrope.

EDW. L. NICHOLS, Cornell University. *New data on the phosphorescence of certain sulphides.

G. P. BAXTER and H. W. STARKWEATHER, Harvard University. *A revision of the atomic weight of tin.

T. W. RICHARDS and H. S. DAVIS, Harvard University. *Improvements in calorimetric combustion.

T. W. RICHARDS and C. WADSWORTH 3d, Harvard University. *Further study of the atomic weight of lead of radioactive origin.

GILBERT N. LEWIS, University of California. *Chemical affinity.

WM. TRELEASE, University of Illinois. *The American oaks.

H. S. JENNINGS, Johns Hopkins University. *The numerical results of diverse systems of breeding, with relation to two pairs of factors, linked or independent.

* Papers marked with an asterisk were presented by title.

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W. R. MILES, Carnegie Nutrition Laboratory, Boston (introduced by F. L. Benedict). *Some psycho-physiological processes as effected by alcohol. (12 minutes.)

WALTER B. CANNON, Harvard University. *Oscillatory variations in the contraction of rhythmically stimulated muscles.

WM. H. DALL, Smithsonian Institution. *On some anomalies in the distribution of Pacific coast mollusks.

G. H. PARKER, Harvard University. *The responses of hydroids to gravity.

W. M. WHEELER, Harvard University. *The phylogenetic development of subapterous and apterous castes in the Formicidae.

W. J. CROZIER, Resident Naturalist, Bermuda Biological Station (introduced by E. L. Mark). *On cell penetration by acids: the chloracetic acids. *On the immunity coloration of some nudibranches.

HOVEY JORDAN, Bermuda Biological Station (introduced by E. L. Mark). *The rheotropism of the marine fish known as "hamlet" or "grouper" (*Epenephalus striatus*).

A. C. WALTON, Harvard University (introduced by E. L. Mark. *The occurrence of *Ascaris triquetra*, Schrank, in dogs.

AFTERNOON SESSION.

This session was devoted to a meeting of the National Research Council with the National Academy.

PROF. GEORGE E. HALE, Chairman of the National Research Council. The work of the National Research Council; Recent observations of organized science in England and France. (45 minutes.)

LIEUT. COL. GEORGE O. SQUIER, Chief of Aviation, United States Army. Scientific research for national defense, as illustrated by the problems of aviation. (20 minutes.)

PROF. ARTHUR A. NOYES, Massachusetts Institute of Technology. The nitrogen problem in war and in agriculture. (30 minutes.)

Discussion of the work of the National Research Council followed.

SCIENTIFIC EXHIBITS.

H. S. WHITE, Vassar College. Graphic representations of triad systems.

FRANK SCHLESINGER, Allegheny Observatory, Allegheny, Pa. Photographs of Jupiter.

Miss A. J. CANNON, Harvard College Observatory. Stellar spectra.

LEON CAMPBELL, Harvard College Observatory. Visual observations of variable stars.

Miss H. S. LEAVITT, Harvard College Observatory. Photographic magnitudes.

SOLON I. BAILEY, Harvard College Observatory. Variable stars in clusters.

A. G. WEBSTER, Clark University. Acoustical measuring apparatus: Standard phone, phonometer, and phonotrope. Application of a drop chronograph for use in ballistics.

CHARLES A. KRAUS, Clark University. A new vacuum pump and a new thermostat.

H. P. HOLLNAGEL, Massachusetts Institute of Technology. Methods of isolating the infra-red region of the spectrum.

ALEXANDER MCADIE, Blue Hill Observatory. Cloud studies, wind structure and snow flakes.

ELLSWORTH HUNTINGTON, Milton, Mass. The relation between solar changes and barometric gradients.

* Papers marked with an asterisk were presented by title.

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ROBERT DEC. WARD, Harvard University. Weather types of the United States, illustrated by composite weather maps and instrumental records.

R. A. DALY and H. CLARK, Harvard University. Design for a deep-sea thermograph.

FRANK HALL, Massachusetts Institute of Technology. A thermophone arranged so that direct comparison may be made with a magnetic receiver.

F. G. KEYES and J. B. DICKSON, Massachusetts Institute of Technology. Continuous flow calorimeter for measuring heats of reaction in solution.

S. P. MULLIKEN, Massachusetts Institute of Technology. A procedure for the identification of pure organic compounds.

C. K. REIMAN, Massachusetts Institute of Technology. Physico-chemical methods for purifying gases and the determination of their molecular weights.

R. E. WILSON, Massachusetts Institute of Technology. Apparatus for maintaining pressures of one-tenth micron or less, and the investigation of the mechanism of chemical reactions.

C. L. BURDICK, Massachusetts Institute of Technology. Determination of crystal structure by X rays.

HENRY FAY, Massachusetts Institute of Technology. Erosion of large guns.

ALBERT SAUVEUR, Massachusetts Institute of Technology and Harvard University: 1. Photomicrographic apparatus (original). 2. Photomicrographs of metals and alloys; charts and diagrams; specimens.

H. O. HOFMAN, Massachusetts Institute of Technology. 1. Jenny flotation machine. 2. A laboratory revolving horizontal roasting furnace heated electrically and rotated in the same way.

A. E. KENNELLY and Associates, Massachusetts Institute of Technology. Researches in electrical engineering.

ALEXANDER KLEMIN, Massachusetts Institute of Technology. Aeroplane models used in wind tunnel.

W. LINDGREN and W. L. WHITEHEAD. Massachusetts Institute of Technology. Photomicrographs of silver ores from Chile and Tintic.

CHARLES PALACHE, Harvard University. Models showing gnomonic crystal projection.

C. H. WARREN, Massachusetts Institute of Technology. 1. A graduated sphere for crystallographic work. 2. Photographs of spherulites in polarized light.

WALLACE W. ATWOOD, Harvard University. The former glaciers of the San Juan Mountains of Colorado. The physiographic stages in the evolution of the San Juan Mountains of Colorado.

J. B. WOODWORTH, Harvard University. Glacial map of Cape Cod and adjacent islands. A glypolith from Nantucket.

LAURENCE LA FORGE, United States Geological Survey. Recent topographic and geologic maps of New England and other parts of the United States.

W. M. DAVIS, Harvard University. New maps of Hawaii, indicating the subsidence of an active volcano.

H. W. SHIMER, Massachusetts Institute of Technology. Evolution of some brachiopods.

RICHARD M. FIELD, Harvard University. Ordovician rocks and faunas of central Pennsylvania.

W. B. SCOTT, Princeton University. Proofs of plates for forthcoming report on paleontology of Patagonia.

EDWARD S. MORSE, Salem. Southern mollusks in the till of Boston Bay.

W. J. V. OSTERHOUT, Harvard University. Pigments produced by the oxidation of a colorless plant chromogen.

CHARLES W. JOHNSON, Boston Society of Natural History. Distribution and variation of Helix hortensis.

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JOSEPH A. CUSHMAN, Boston Society of Natural History. Some fossil and recent foraminifera.

ALFRED G. MAYER, marine laboratory, Carnegie Institution. Yacht and laboratory of the Carnegie Institution at Torturas, Florida.

HUBERT LYMAN CLARK, museum of comparative zoology, Harvard University. Echinoderms from Torres Straits, Australia, with colored drawings and lithographs.

G. H. PARKER, Harvard University. The suction efficiency of a Californian sea anemone.

W. T. BOVIE, Harvard University. Visible effects of Schumann rays on protoplasm. Effects of radium rays on permeability of protoplasm.

W. M. WHEELER, Bussey Institution, Harvard University. Insects associated with ants and termites.

C. T. BRUES, Bussey Institution, Harvard University. Specimens and charts illustrating insects as carriers of infantile paralysis.

FREDERIC G. CARNOCHAN, Bussey Institution, Harvard University. Collections of beetles of the family Histeridae, with photographs of the anatomy.

W. E. CASTLE, Bussey Institution, Harvard University. Examples of Mendelian inheritance, reversion and variety formation in rats and guinea pigs.

FRANCIS G. BENEDICT, nutrition laboratory, Carnegie Institution. Respiration apparatus for animals.

T. B. OSBORNE, Connecticut Agricultural Experiment Station, and L. B. MENDEL, Sheffield scientific school, Yale University. Photographs representing the growth of chickens fed with definite mixtures of food stuffs under laboratory conditions which have heretofore not led to success.

I. CHANDLER WALKER, medical service, Peter Bent Brigham Hospital. Proteid sensitization in relation to bronchial asthma.

H. S. WELLS, medical service, Peter Bent Brigham Hospital. Electrocardiography, or the application of the string galvanometer to the study of cardiac cases.

ALBERT A. GHOREYEB, Cancer Commission, Harvard University. Metal casts of heart and kidney blood vessels.

S. B. WOLBACH, Harvard Medical School. Studies in Rocky mountain spotted fever.

HARVEY CUSHING and W. M. BOOTHBY, Peter Bent Brigham Hospital. Apparatus of routine methods for clinical metabolism determinations.

E. W. GOODPASTURE, Peter Bent Brigham Hospital. An anatomical study of senescence, with especial reference to tumors.

E. E. TYZZER and C. C. LITTLE, Harvard Medical School. The inheritance of susceptibility to transplanted tumor.

W. DUANE, Harvard Medical School. The technique of the preparation of radium for therapeutic purposes.

G. C. WHIPPLE, school for health officers, of Harvard University and Mass. Inst. Technology. Charts showing organization and membership of the school.

W. T. SEDGWICK, Massachusetts Institute of Technology. 1. Diagrams and tables illustrating the investigations of Professor Weston and Mr. Turner upon 'The digestion of sewage effluents in an otherwise unpolluted stream." 2. An investigation of the behavior of certain species of bacteria in various materials between zero Centigrade and zero Fahrenheit. 3. A field investigation of the sanitary environment of a suburban population.

S. C. PRESCOTT, Massachusetts Institute of Technology. Diseases of the banana in Central America, and their control.

ALFRED M. TOZZER, Peabody Museum, Harvard University. Race mixture in Hawaii.

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CHARLES PEABODY, Peabody Museum, Harvard University. Prehistoric specimens from caves of France and Palestine.

E. A. HOOTON, Peabody Museum, Harvard University. Casts and reconstruction of ancient man; skull of apes.

S. J. GUERNSEY, Peabody Museum, Harvard University. Cave explorations in northeastern Arizona.

ORIC BATES, Peabody Museum, Harvard University. Prehistoric Libyan remains.

HENRY DRAPER MEDALLISTS.

The Draper medal was awarded to W. W. Campbell, now director of the Lick Observatory, at the annual dinner of the National Academy of Sciences in 1906. A statement of this award was omitted from the annual report of that year and for that reason was not included in the semicentennial volume, entitled "The National Academy of Sciences, 1863–1913." The list of recipients of the Draper gold medal should read:

1886. Samuel Pierpont Langley: For researches and discoveries in relation to solar radiation.

1888. Edward Charles Pickering: For recent work in astronomical photometry and photography.

1890. Henry Augustus Rowland: For researches in the solar spectrum.

1893. Herman Karl Vogel: For spectroscopic observations upon the motion of stars in the line of sight.

1899. James Edward Keeler: For researches in spectroscopic astronomy.

1901. Sir William Huggins: For investigations in astronomical physics.

1904. George Ellery Hale: For investigations in astronomical physics.

1906. W. W. Campbell: For his observations and researches relating to the motions of stars in the line of sight, his improvements in the methods of measuring such motions, his discussions of conclusions to be drawn from them, and the organization of work in this field in the southern hemisphere.

1910. Charles Greeley Abbott: For researches on the infra-red region of the solar spectrum and his accurate measurements, by improved devices, of the solar "constant" of radiation.

1913. Henri Deslandres: For physical observations of solar eclipses; investigations of electric and magnetic phenomena of the sun; contributions to our theories of auroras, new stars, and nebulae; studies of spectra of the sun, stars, and comets, and photographic determinations of the rotation period of planets.

1915. Joel Stebbins: For his work on the application of the selenium cell to stellar photometry.

DECEASED MEMBERS.

ARTHUR WILLIAMS WRIGHT.

Prof. Arthur Williams Wright died at his home in New Haven, Conn., on December 19. He was born on September 8, 1836, in Lebanon, Conn., where his father, Jesse Wright, at one time a member of the Connecticut House of Representatives, served as justice of the peace, selectman, and a member of the school board. Samuel Wright, who settled in Springfield, Mass., in 1639, was his earliest paternal

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ancestor in this country. His mother was Harriet, daughter of William Williams and a descendent of Robert Williams, who came to this country from England in 1637, settling at Roxbury, Mass.

He received his early education in his native town, preparing for college, under William Kinne, at Canterbury. His career as an undergraduate at Yale College was a distinguished one. He not only achieved notable successes as a scholar in mathematics and astronomy, his studies of predilection, and in Latin, but he was prominent in undergraduate social life. A lifelong love for music naturally led him to identify himself with the musical organizations of his time, and a critical knowledge of music, including an enviable skill in performance, added largely to the pleasures of his later and more leisurely life.

After graduation he continued his studies at Yale, specializing in mathematics and science, and acquired the degree of Ph. D. in 1861. From this time until his retirement in 1906 his life was identified with Yale, except for a period in 1868–69, when he studied at Heidelberg and at Berlin, and the three years 1869–1871, during which he held a professorship of physics and chemistry at Williams College. In the last-named year he returned to Yale as professor of molecular physics and chemistry.

One of Prof. Wright's most distinguished services to his university, and indeed to the teaching of science in America, was the early recognition that the practice of combining professorships of physics and of chemistry had ceased to be either economical or possible. It was, therefore, under his stimulus and activity that the first Sloane Laboratory of Yale College, the first structure in the country devoted exclusively to the work of a physical laboratory in the modern sense—was designed and constructed. This was completed in 1883, and henceforth he devoted his time, until his final retirement, to instruction and various physical investigations there, although the title of his professorship was not changed to that of molecular physics until 1887. This Sloane Laboratory also contained the study and lecture room of Prof. J. Willard Gibbs, whose contributions to physical sciences have made it celebrated for all time.

The greater portion of Prof. Wright's scientific work found its first publication in the "American Journal of Science." These contributions are not merely important, they are characterized by rare excellence of form and of clarity.

In Volumes IX to XII we find a series of papers, five in all, of great interest, on the gaseous contents of meteoric irons and stones. In the first of these papers he reviews the known results of the investigations upon the occluded gases of meteoric irons, quoting Prof. Graham and Prof. J. W. Mallett. In his own investigations the material came for the most part from the collection in the possession of Yale

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University. His conclusions in this first paper were that no one of the several irons which he studied gave any spectroscopic evidences of unknown elements.

In volume X, "Examination of gases from the meteorite of February 12, 1875," Prof. Wright gives a thorough review of the gaseous contents of this meteor. It appears to be the first stony meteor thus investigated, and the results are of great importance; they not only show the presence of gases occluded in stony meteors but that they are distinguished by having oxides of carbon as their characteristic gases, instead of hydrogen. He points out the bearing of these observations upon the peculiar spectra of comets and as a support of the meteoric theory of comets.

In volumes XI and XII Prof. Wright continued these important investigations, extending them to a considerable number of stony meteors of known origin. The earlier conclusion that stony meteors are characterized by a large amount of occluded carbon compounds was abundantly verified, and the last paper contains a long discussion concerning the bearing of these observations on the current theory of comets.

In 1877 Prof. Wright published two important papers, in volumes XIII and XIV, respectively, on the deposition of metallic films by the cathode discharge in exhausted tubes. A clear description of the technique of the process and of the physical properties of a large number of metals thus treated makes the papers of unusual interest. The intrinsic value of his method has proved so great that it is quite probable that the name of the author is more widely known from these scientific contributions than from any others published during his long and active life.

Prof. Wright was a fellow of the Royal Astronomical Society of Great Britain and of the American Association for the Advancement of Science; he was a member of the American Physical Society, of the National Academy of Sciences, and of other learned societies.

C. S. HASTINGS.

(Extract from Science, n. s. Vol. XLIII, No. 1104, Feb. 25, 1916, p. 270.)

JOSIAH ROYCE.

In the sixth book of "The Republic," Plato paints the portrait of the ideal or, as he says, "the true" philosopher. He must be a man of quick mind and retentive memory, devoted to truth and abhoring falsehood in every shape, temperate, and thoroughly uncovetous, with no taint of meanness or little-mindedness or cowardice, gentle and just in his dealings with men; one whose spirit is full of lofty thoughts and privileged to contemplate all time and all existence, and who is, therefore, fearless in the face of death; one who is enamoured of all learning that will reveal somewhat of that real and

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permanent existence which is exempt from the vicissitudes of generation and decay, and of the whole of that real existence, willingly resigning no part of it, great or small, honored or dishonored.

A rare combination! And the fortunate possessor of these gifts now, as in ancient Athens, is almost irresistably enticed away into less exalted pursuits.

Plato goes on to describe how puny souls, seeing the fair field of philosophy all but deserted, rush in to take possession, likening them to some baldheaded little tinker who has suddenly amassed a fortune, and taking advantage of his master's poverty, married his daughter. What can one expect in such a case but a base-born progeny! What in the former case but a spurious brood of sophistries! Whether this description fits our day, let the reader decide. Certain it is that the virtues Plato enumerates as essential to full capacity for philosophy were in Josiah Royce singularly combined, and that from his youth up he was steadfastly and unreservedly devoted to the cause of truth.

I am impressed by the massiveness of his learning. His mind was fashioned on cosmic proportions. I do not mean by this merely that his interest centered in la haute metaphysique, and that he fearlessly faced the problems, old as reflective thought itself, concerning God and nature and man, interpreting them in the light of recent scientific discoveries, and giving us new readings of ancient issues. Nor do I refer to the wide range of his intellectual interests, although as a polymath he ranks with the greater philosophers of the past, making contributions to mathematics and logic as well as to all the more strictly philosophical disciplines, and being familiar to an unusual degree with the work of recent science in its various fields.

On one occasion at a club some one who had made a special study of the subject read a paper on meteorology, a theme that might seem remote enough from philosophical interests. Royce discussed it, and, such was his evident mastery of the subject, for the rest of the evening questions were addressed to him rather than to the reader of the paper. The instance is typical. He was always surprising one with such glimpses of hidden lore.

But what I have in mind is rather this: Royce never lost sight of the fact that philosophy's ambitious aim is vision in the light of the whole. And he always lived with his vision. This gave him not only his unusual serenity and poise, but also a facility (sometimes an almost suspicious facility) in piecing together the fragments of knowledge like the fragments of a puzzle picture until the pattern of the whole was revealed. And all the little and seemingly trivial incidents of life were, for him, fraught with universal significance.

Once on a street car in New York he had occasion to take a transfer. But he never put it to its intended use. It was too precious

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for that. For on the back was an advertisement in which these sentences appeared:

> Individuality sets you apart from all other persons who might possibly be just like you. The average woman feels that she might as well be dead as to be out of fashion. She wants to wear what everybody else wears, but it must be with a difference.

And this transfer slip becomes the text of a lecture on dialectic, on identity and difference, and the principle of individuation. I may be pardoned for mentioning these incidents, for they illuminate the character of the man. There was something essentially Socratic in this habit of elevating the commonplace and in this combination of the serious and the playful.

James once remarked that the average undergraduate rarely understood Royce, but that he always had a sense that something big was going on. He was not, indeed, a successful teacher of undergraduates. This is, however, less a reflection on Royce than on the undergraduate, who has been pretty generally spoiled and expects to have truth handed to him diluted and peptonized. Royce never insulted the intelligence of his students by offering them a consistent and tenable theory of the universe wrapped in neat word packages. But in dealing with the graduate students he was masterful, always encouraging their independent efforts, giving them confidence in themselves and in the power of reason, yet always ready to put to rout the overconfident zealot by piercing his pet dogmas with a few skillful questions. He always showed a rare intellectual detachment. He was never the partisan of his own convictions; never sought to make proselytes. Never was an absolutist less concerned with having followers. Philosophy as he viewed it was always an individual venture, and he knew that only the least original of students ever repeat a teacher's views, and that one's most helpful collaborators are often one's severest critics.

But, above all, at this time, one must think of Royce as preeminently a good man, gentle and kindly, generous and unworldly, whose life was the embodiment of the philosophy of loyalty that he taught. In the face of the greatest personal affliction that can befall a man, his courage was undaunted, his head "bloody but unbowed." A few years ago, suffering an attack which would have led most men to surrender, he was but stimulated to greater effort, and put forth some of his best work, as if his intellect burned on with increasing brilliancy as his frail body wasted away; until, finally, the machinery stopped, and he fell asleep as peacefully as a tired child. We bow our heads and are fain to repeat the words a loving disciple uttered on the death of another great teacher of philosophy: "So perished the wisest and best man I have ever known."

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At its last annual meeting the American Philosophical Association, in memory of his sixtieth birthday, did Prof. Royce the signal honor of devoting two of its sessions to papers dealing with various phases of his work as a philosopher. These papers, with some others, have since been published as a commemorative volume by the Philosophical Review. This makes at once more difficult and less necessary the attempt to give here a critical estimate of his contributions to philosophy in its more technical aspects. I shall therefore confine myself to more general considerations.

The three names that stand out in the history of American speculative thought, preeminent above all others, are Jonathan Edwards, William James, and Josiah Royce. What Edwards accomplished in interpreting the spirit of American life and ideals in his day, James and Royce have accomplished in interpreting the spirit of American life and ideals in our own day.

It is customary to represent James and Royce as totally opposed in their philosophies, the one an empiricist and pragmatist, the other a rationalist and absolute idealist. I have no desire to minimize the differences between them—and they were frequently engaged in polemical controversy. But on the great thinkers all labels are misfits. And with them agreements are generally more numerous and more fundamental than differences. In this case I think the philosophies are complementary rather than antagonistic. It is certain that Prof. Royce regarded himself as a disciple of Prof. James, however unruly a one he may have been, and always generously acknowledged his indebtedness to him. And James was no less generous in the expression of his admiration for his younger colleague.

It is significant that both men received their early inspiration from men of science—the one from Agassiz, the other from Agassiz's brilliant pupil, Joseph Le Conte. Both were caught by the theory of evolution, were its enthusiastic exponents, and were bent on interpreting the larger problems of human life in its light. It is, however, no less significant that in their earliest scholarly activity James turned to anatomy, physiology, and psychology; Royce to literature, history, and logic. For as these differences suggest, James was from the first more interested in details, Royce in the completed vision.

This difference, which determines the divergence of their paths, is not unconnected with their personal history. James, brought up in the very center of New England culture, a social favorite from the start, breathing an atmosphere of absolutism and rationalism, is stifled by his surroundings, and, in search of air, freedom, elasticity, makes his escape to science and psychology. The bogeys in the background of his thinking are ever after verbalism, closed systems, and drab respectability. Royce, on the other hand, was born and

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spent his early years in a small mining town in California, at a time when frontier lawlessness and the days of the Vigilantes were still fresh in memory. The young Royce was uncouth, and awkward, and of very unusual appearance, with a slight body and a very large head (mostly forehead), crowned with a shock of bright red hair. Boys are cruel to a fellow of such strikingly unconventional appearance, and as Royce has said, although his classmates early taught him the "majesty of the community," he found the experience grievous rather than joyous. A certain shyness resulted, and both at school in San Francisco and later at the University of California he was essentially the solitary student, given much to reflection, but knowing little or nothing of the social and sportive sides of college life. The bogeys in the background of his thinking are ever after lawlessness, capriciousness, fragmentariness, and isolation; and he seeks refuge in those humane pursuits which ever aspire to a certain comprehensiveness of vision—literature and history and philosophy. But he is saved from vagueness and sentimentalism by the stiffening effect of logic. It was characteristic that when, after studying at Johns Hopkins and in Germany, he returned to his alma mater to take a position in English literature, he should have decided that his students needed discipline in logic, and that, finding no book on logic suited to his needs, he wrote one. For as James is always the psychologist, gifted with unusual powers of observation and description, so Royce is always the logician, as skillful in its art as he is master of its theory.

Both men were fearless and intrepid thinkers, singularly free from cant, and distrustful of all formulas, knowing well that when thought has crystallized in the phrase, the life of thought has departed. Both sought merely to interpret the facts of experience as they themselves had found them. Both, however, saw clearly that facts are not such simple things as the average fact-monger supposes; but that part at least of their meaning comes through the cooperation of the experiencer. And hence for both the ethical and religious interests are never long out of sight. Royce's first philosophical book is "The religious aspect of philosophy," and almost his last, "The problem of Christianity." Most of the essays in James's "Will to believe" were written early in his career, and the "Varieties of religious experience" comes toward its close.

In the all too simple classification of the day, James is set down as an empiricist, Royce as a rationalist; which distinction is explained by saying that the former looks to last things, facts, consequences, while the latter looks to first things, causes, principles. This is true enough as far as it goes. But it must be remembered that for James facts always include those larger human experiences which defy description in terms of the visible and tangible; and surely he was as

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far removed as Royce himself from the position of the pseudo-scientific philosopher, our modern positivist, who is in truth the representative in our day of the spirit of medievalism, with its fondness for verbal solutions and its tendency to hypostasize abstractions. And for Royce principles are not decrees fulminated from eternity, in advance of facts, but are rather the threads of meaning that run through the facts of experience and bind them together.

Again, Royce is called a monist, James a pluralist. In his earliest work Royce does indeed find the desired unity in the concept of the Absolute or Logos, in whose life our partial purposes and fragmentary meanings are harmonized. The monistic tendency of this work was early the object of attack, the most notable assault being that of Prof. Howison, against which Prof. Royce sought to defend his doctrine in the supplementary essay published in "The concept of God." And I think it is clear that a large part of Prof. Royce's work throughout the remainder of his career is determined by this controversy and by similar attacks coming from other quarters, especially from his friend and colleague, James. His chief concern is to find in the world of the Absolute, elbow-room for the individual. And when, in his latest work, what he called "The Spirit of the beloved community" has taken the place of the Absolute of the earlier works, the term monism is hardly pertinent any longer. James, on the other hand, found forthwith the desired variety in the facts of experience. But I think it not an exaggeration to say that he spent his life in seeking to recover the lost unity through the discovery and justification of the faiths by which men actually live—which is what alone can save pragmatism from being merely a subtler form of opportunism.

Together, these two men stand as our great national philosophers, helping to define and make articulate the spiritual aspiration that underlies our experiment in democracy and justifies our confidence in its ultimate triumph, the one approaching his task mainly from the side of logic, the other mainly from the side of psychology.

We have, or flatter ourselves that we have, at last broken away from authority and tradition and dogma; we call ourselves progressives, are lovers of the concrete, believe in efficiency and the strenuous life, and admire, above all things, the man who "makes good." But while in its blatant spokesmen this Americanism smacks overmuch of the market-place and the athletic field, it is saved from such debasement by that deeper current of ethical idealism to which these thinkers have so clearly given voice.

CHARLES M. BAKEWELL.

(Extract from the Nation, Nov. 16, 1916, p. 461.)

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EUGENE WOLDEMAR HILGARD.

Eugene Woldemar Hilgard was born January 5, 1833, at Zweibruecken, in Rhenish Bavaria, the son of Theodore Erasmus and Margarethe Hilgard, and was the youngest of a family of four sons and five daughters. His father was a lawyer, holding the position of chief justice of the court of appeals of the province. Judge Hilgard having been born and educated under the shadow of the French Revolution and being of pronounced liberal views, stoutly opposed the supersedence of the Code Napoleon by the illiberal laws of the old régime. In 1838, when at the fullness of a successful career, he determined to emigrate to America with his family and settled on a farm at Belleville, Ill. As the public schools of that day were quite primitive Judge Hilgard personally undertook the preparation of his sons for entrance to the universities. Eugene was in readiness in 1849 and in that year returned to Germany to attend the University of Heidelberg, graduating with honors and a doctor's degree with summa cum laude in 1853. This degree was reissued to him in 1903 as a "golden degree" in recognition of half a century's good work for science. Returning to America, he began geological exploration work in Mississippi in 1855 and was appointed State mineralogist of that State in 1858. In 1866 he was chosen professor of chemistry in the University of Mississippi and later professor of geology, zoology, and botany. In 1872 he left Mississippi to take a position on the faculty of the University of Michigan, but remained there only two years, when he was called by the regents of the University of California to California in 1874. While developing agricultural instruction in the university, he proceeded with research work immediately after his arrival in California and published his first results in 1877. His work in the investigation of soils in connection with their native vegetation, of the influence of climate on the formation of soils, and especially of the nature of "alkali soils" and their reclamation, a problem quite new not only in this country, but in other arid regions, achieved for him a reputation as wide as the world of science. It brought him recognition on numerous occasions. Mississippi, Columbia, and Michigan Universities, as well as the University of California, have bestowed the doctor of laws degree upon him. The Academy of Sciences of Munich presented him with the Liebig medal for distinguished achievements in the agricultural sciences, and the international exposition at Paris, in 1900, gave him a gold medal as a collaborator in the same research.

Soon after coming to California he directed the agricultural division of the northern transcontinental survey. From 1879 to 1883, in connection with his university work, he assumed charge of the cotton investigation of the census of 1880 which he projected and

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carried out on a broader plan than ever before undertaken. During the whole period of his academic career Prof. Hilgard was constantly active in authorship. In addition to formal reports and memoirs, he wrote much for agricultural and scientific periodicals. His greatest book is Soils of Arid and Humid Regions.

The greater part of Hilgard's career was spent at the University of California. Of the many and various problems which he faced at the beginning of his work there, three seem at this moment to give best clue to the masterfulness of the man and fullest understanding of the breadth and depth of his success:

First. The conciliation and conquest of his farming constituency by demonstration of practical and indispensable value in the work he could do.

Second. The enforcement of recognition of agricultural studies as entitled to the dignity of higher learning and as possessed of pedagogic value.

Third. The securing of funds to pursue research which could alone yield truth about natural conditions affecting California farming, and to increase his working force, without which he could neither get the truth nor teach it in its several branches and applications.

Hilgard's work was permanently successful, because with clear vision he founded it upon principles the soundness of which has since been demonstrated and generally recognized. In his first report, published in 1877, he said:

> A knowledge of facts and principles and not the achievement of manual dexterity must be the leading object of a truly useful course of instruction in agriculture. * * * Object teaching should be made the preeminent method of instruction in natural and, more especially, in technical science. Manual exercise should be made the adjunct of the instruction in principles.

The stand taken by Hilgard with reference to the dignity and pedagogical value of agricultural science while so many institutions now great were in their formative periods was recognized as sound throughout this country and beyond. Set forth in his early reports, it exercised a profound influence. The proper relation of agricultural practice to agricultural science as factors in educational effort; the educational distinction between labor performed for enlightenment and labor prescribed to beget a liking for labor; the place of both the art and science of agriculture in a university of higher learning when both are handled ably for instructional purpose—these were among his fundamental contentions, upholding them through many controversies, and his victory is seen in their entry into the regular curricula of all of the newer institutions of learning and their pursuit by older institutions established upon other standards of learning before the existence of these educational factors was dreamed of as worthy and capable.

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Hilgard's strategic diversion of 1879 and 1883 was one of the brightest and most effective movements of his career. On the basis of his work in Mississippi he was requested by the Director of the Census of 1880 to take full charge of the cotton investigations for that census and to do something greater for the cotton industry than was ever done before, and he was promised funds for inquiry, investigation, laboratory work, and whatever else he deemed necessary to get at the fundamental facts and principles connected with cotton growing in the United States. He reviewed the subject as a whole and in divisions, studied each cotton State, and finally, after four years of work, produced in two volumes his report upon the cotton industry of the United States, a lasting benefit to all cotton-producing States. This report, in two quarto volumes, was a force in engrafting original research upon the instructional work established through the educational land-grant law of Morrill, by the enactment of the Hatch law for State experiment stations in all States.

The results of Hilgard's labors are in the warp of California's first half century of intellectual and industrial life. He was quick to see his opportunities for public service, to recognize his duty therein, and he was masterful and tireless in pursuit of it. He was bold in conquest of truth and fearless in his use of it for the interest of mankind, seizing gladly the smallest fact from research and pressing it to the humblest service, but always perceiving and enforcing the relations of both the fact and the service to the broadest interests of his States and of his fellow men.

E. J. WICKSON.

(Extract from Science, n. s., Vol. XLIII, No. 1109, p. 447.)

CLEVELAND ABBE.

The death of Cleveland Abbe near Washington, D. C., on October 28, in the seventy-eighth year of his age makes a gap of a special character in the ranks of meteorologists, and particularly among those who use the English language. From 1871 until August last, when he retired, Abbe was professor of meteorology in the United States Weather Bureau. That is the title which the bureau gives to the professional meteorologists on its staff. Born and educated in New York, he had been a teacher of mathematics in New York and of engineering at the State University, Ann Arbor, Mich. From there he went to Harvard University, 1860–1864, being at the same time aid in the United States Coast Survey under B. A. Gould; thence to the Central Observatory of the Russian Meteorological Service at Petrograd for two years; aid in the United States Naval Observatory, 1867–68, and director of the Cincinnati Observatory, 1868–1873.

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The work at the Weather Bureau for which he is best known is the editing of the Monthly Weather Review, which was in his charge from 1893 until his retirement, with a break of a few years from 1909, during which the Bulletin of Mount Weather Observatory took its place. Besides original papers, it includes the best monthly epitome of progress in meteorology in English, and ranks for that purpose with the Meteorologische Zeitschrift. This work gave Abbe an unrivalled knowledge of meteorological literature. He was a sort of college-tutor for the Weather Bureau, and with his encyclopaedic knowledge he was to a large extent the force behind the organization. He was a very keen advocate of the study of dynamical meteorology. Every student of the subject knows his collections of translations into English of classical papers in French and German which are published by the Smithsonian Institution. He founded a meteorological library at Johns Hopkins University and was professor of meteorology in the George Washington University of Washington. He was specially the promotor of meteorology. We owe to his instigation the installation by the Meteorological Office of the station now in operation at St. Helena. He wrote a large volume on the Maryland Weather Service, with a discourse upon aims and methods. That represents his interest. In an article in the "Encyclopaedia Britannica" it is the observation of clouds at sea that claims attention. He took part in a number of scientific expeditions for eclipses and other purposes, and he started the reform in civil time, reckoning by even hours from the Greenwich meridian, a reform which in Europe has over-shot itself into "summer-time."

Abbe's services to meteorology were recognized by the Royal Meteorological Society by the award of the Symons medal in 1912. He was a man of most genial disposition. His wife, the daughter of W. G. H. Percival, of St. Kitts, whom he married in 1909, survives him. One of the sons of his first marriage, Cleveland Abbe, junior, succeeds him as editor at the Weather Bureau.

NAPIER SHAW.

(Extract from Nature, vol. 98, No. 2461, Dec. 28, 1916, p. 332.)

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ANNUAL REPORT OF THE TREASURER.

JANUARY 1 TO DECEMBER 31, 1916.

To the PRESIDENT OF THE NATIONAL ACADEMY OF SCIENCES:

I have the honor to submit the following report as treasurer for the fiscal year, January 1 to December 31, 1916. Before presenting the detailed statements of the report some special features of the financial transactions of the year will be mentioned.

The income of the academy during the year from dues, investments, subscriptions to Proceedings, contributions to the Proceedings fund, and William Ellery Hale lectureship was $16,753.45. The miscellaneous expenditures, exclusive of investments, amounted to $8,536.43. Payments made on grants from various funds in aid of research and for medals amounted to $9,389.07.

The sum of investments held by the academy on December 31 was $228,001, yielding on that date at the rate of 4.99 per cent. The total income from investments received during the year was $11,814.94.

Changes in investments may be summarized as follows: One series of first mortgage notes on real estate amounting to $10,000 was paid in full, one was curtailed by the payment of $5,000 and three bonds of $1,000 each were called, and $3,020 paid for them. Bonds were purchased to the amount of $18,713.75.

The academy received during the year the sum of $6,921.84 from the estate of the late O. C. Marsh as deferred interest from March 18, 1900.

The special fund contributed by the members and friends of the academy toward the expenses of the publication of the Proceedings amounted to $2,178.33.

On February 1 the consolidated investment fund was established, as provided by the constitution and a resolution of the council. It embraces the capital of the Agassiz, Bache, Building, Draper, Elliot, Gibbs, Hartley, Marsh, and Smith funds, aggregating $159,827.18.

TRUST FUNDS OF THE ACADEMY.

The trust funds of the academy, the income of which is administered for specific purposes, are enumerated below. The capital of certain funds has been increased beyond the amount of the original gift or bequest, by the transfer of accumulated income, at the request of the donors or by action of the academy.

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Bache fund: Bequest of Alexander Dallas Bache, a member of the academy, 1870. To aid researches in physical and natural sciences $56,000.00

Watson fund: Bequest of James C. Watson, a member of the academy, 1874. For the promotion of astronomical science through the award of the Watson gold medal and grants of money in aid of research 25,000.00

Draper fund: Gift of Mrs. Henry Draper, 1883, in memory of her husband, a former member of the academy. To found the Henry Draper gold medal, to be awarded for notable investigations in astronomical physics. The balance of income is applied to aid research in the same science 10,000.00

Smith fund: Gift of Mrs. J. Lawrence Smith, 1884, in memory of her husband, a former member of the academy. To found the J. Lawrence Smith gold medal, to be awarded for important investigations of meteoric bodies and to assist, by grants of money, researches concerning such objects 10,000.00

Gibbs fund: Established by a gift of Wolcott Gibbs, a member of the academy, 1892, and increased by a bequest of the late Morris Loeb, 1914. For the promotion of researches in chemistry 5,545.50

Gould fund: Gift of Miss Alice Bache Gould, 1897, in memory of her father, a former member of the academy. For the promotion of researches in astronomy 20,000.00

Comstock fund: Gift of Gen. Cyrus B. Comstock, a member of the academy, 1907. To promote researches in electricity, magnetism, or radiant energy, through the Comstock prize, of money, to be awarded once in five years for notable investigations. The fund is to be increased ultimately to $15,000 ..... 11,337.50

Marsh fund: Bequest of Othniel Charles Marsh, a member of the academy, 1909. To promote original research in the natural sciences 10,127.65

Murray fund: A gift from Sir John Murray, 1911, to found the Alexander Agassiz gold medal, in honor of a former member and president of the academy, to be awarded for original contributions to the science of oceanography 6,000.00

Hartley fund: A gift from Mrs. Helen Hartley Jenkins, 1913–14, in memory of her father, Marcellus Hartley, to found the medal of the academy awarded for eminence in the application of science to the public welfare 1,200.00

In addition to the above-named trust funds the academy holds the following:

Agassiz fund: Bequest of Alexander Agassiz, a member of the academy, 1910, for the general uses of the academy $50,000.00

Building fund: A gift from Alexander Agassiz and Theodore N. Gill, former members of the academy, toward a building for the academy, together with accumulated income to Dec. 31, 1916 ..... 8,954.03

STATEMENTS OF ASSETS AND LIABILITIES, DECEMBER 31, 1916.

ASSETS.

1. Mortgage notes, secured by first mortgages on real estate $90,750.00
2. Bonds, giving name, face value, rate of interest, and cost:
   - 4 Asheville Power & Light Co. first mortgage, 30-year gold, 5 per cent, due Apr. 1, 1942. New York. Nos. 490, 492, 508, 509 ..... $3,920.00

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2. Bonds, etc.—Continued.

12 Broadway Realty Co. first, 5 per cent gold, due Sept. 1, 1926. Purchase money. 12 at $1,000. Nos. 38, 50, 796, 963–5, 1068, 1616–20	$12,345.00
10 Bush Terminal Building Co. first-mortgage 50-year sinking fund, 5 per cent gold bonds, due Apr. 1, 1960. 10 at $1,000. Nos. 1383–7 and 2805–9	9,375.00
5 Chesapeake & Ohio general mortgage 4.5's, gold bonds, due Mar. 1, 1992. 5 at $1,000. Nos. 15350, 15351, 15352, 15353, 15354	4,600.00
4 City of Tacoma Green River special water fund No. 2, 5 per cent, due Oct. 1, 1939. 4 at $1,000. Nos. 1508, 1809, 1510, 1511	4,140.00
7 Cleveland Electric & Illuminating Co. first-mortgage 5 per cent gold bonds, due Apr. 1, 1939. 4 at $500 and 3 at $1,000 each. Nos. M6060, M6096, M6097, D261, D262, D263, D264	5,097.50
19 Cosmos Club 4.5 per cent bonds, due July 1, 1949. 29 at $1,000. Nos. 286–297, 299, 301–305, 350	19,000.00
7 Detroit Edison Co. 5's, first mortgage, 30-year gold, due Jan. 1, 1933. 7 at $1,000. Nos. 557, 2442, 2443, 3024, 3252, 3253, 8086	7,177.50
5 Dominion Coal Co. (Ltd.) first-mortgage sinking-fund gold bonds, 5 per cent, due May 1, 1940. 5 at $1,000. Nos. A1036–A1040	4,675.00
2 Georgia Railway & Electric Co. first consolidated mortgage 5's, sinking fund, gold, due Jan. 1, 1932. 2 at $1.000. Nos. 1061, 1600	2,055.00
13 Government of the Province of Alberta bonds, 4.5 per cent, 10-year gold debenture, due Dec. 1, 1923. 2 at $500 and 11 at $100. Nos. 2031 and 2032, 1501–1511	2,008.50
6 Government of the Province of Alberta bonds, 5 per cent, 10-year gold debenture, due May 1, 1925. 1 at $1,000 and 5 at $500. Nos. 2364, B189–B195	3,373.75
1 Government of the Province of Alberta bond, 4.5 per cent, 10-year gold debenture, due Feb. 1, 1924. 1 at $500. No. 2620	480.00
4 Grand Rapids Gas Light Co., 5 per cent, first mortgage gold, due New York, August 1, 1939. 4 at $1,000. Nos. A522, A523, A595, A596	4,020.00
9 Milwaukee Railway & Electric Light Co. general and refunding mortgage gold bond, series A, 5 per cent, due Dec. 1, 1951. 6 at $1,000. Nos. 2772, 5222, 5223, 5224. 3839, 3840, 3930, 3931, 2088	8,237.50
6 Minneapolis General Electric Co. 5 per cent 30-year gold mortgage bonds, due Dec. 1, 1934. 6 at $1,000. Nos. 1621, 1622, 1949, 2004, 7579, 7580	6,100.00

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2. Bonds, etc.—Continued.		
4 Niagara Falls Power Co. first mortgage, 5's, gold coupon bonds, due Jan. 1, 1932. 4 at $1,000. Nos. 5246, 5247, 6583, 8358	$4,100.00	
18 Riggs Realty Co. 3/30-year coupon bond, first, 5's, due Oct. 1, 1940. 18 at $1,000. Nos. 76, 80, etc., to 144	18,572.50	
9 Southern Bell Telephone & Telegraph Co. 30-year, first mortgage, 5's, sinking fund, gold bonds. Due Jan. 1, 1941. 9 at $1,000. Nos. M9739, M11576, M11577, M11578, M11579, M13965, M15568, M15569, M15570	8,942.50	
1 Union Electric Light & Power Co. of St. Louis, first, 5's, due Sept. 1, 1932. 1 at $1,000. No. 4169	1,010.00	
5 Vicksburg, Shreveport and Pacific Railroad Co. Prior lien mortgage, at 6 per cent, gold bond, due Nov. 1, 1915, extended at 5 per cent to Nov. 1, 1940. Nos. 561, 661, 794, 982, 1323	5,050.00	
3 Virginian Railway Co., 1st mortgage, 50-year gold bond, series A, at 5 per cent, due New York, May 1, 1962. Nos. M4290, M4291, M14151	2,971.25	
		$138,015.60
3. Bank balance, Dec. 31, 1916[1]		29,551.64
		257,552.64

LIABILITIES.

	Income.	Capital.
General fund:		
Invested	$4,686.25	
Uninvested	1,006.96	
Agassiz fund:		
Invested[2]		$50,000.00
Uninvested		
Bache fund:		
Invested[2]	2,575.00	56,000.00
Uninvested	909.35	
Building fund:		
Invested[2]		8,954.03
Uninvested		
Comstock fund:		
Invested	677.50	11,315.00
Uninvested	1,297.32	22.50
Consolidated fund:		
Invested		
Uninvested	1,742.30	
Draper fund:		
Invested[2]	1,952.50	10,000.00
Uninvested	245.19	
Elliot fund:		
Invested[2]		8,000.00
Uninvested	114.98	

[1] Three outstanding checks, $82.25.

[2] Full amount of capital invested as part of the consolidated fund.

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Gibbs fund:		
Invested [1]		$5,545.56
Uninvested	$272.25	
Gould fund:		
Invested	4,067.50	17,963.75
Uninvested	929.06	2,036.25
Hale lectureship:		
Invested		
Uninvested	1,000.00	
Hartley fund:		
Invested [1]		1,200.00
Uninvested	108.98	
Marsh fund:		
Invested [1]	677.50	10,127.65
Uninvested	8,031.95	
Murray fund:		
Invested		5,965.00
Uninvested	274.97	35.00
National research council:		
Invested		
Uninvested	50.00	
Proceedings:		
Invested		
Uninvested	1,218.37	
Smith fund:		
Invested [1]	1,532.50	10,000.00
Uninvested	841.38	
Watson fund:		
Invested		24,922.50
Uninvested	1,176.15	77.50
	35,387.96	222,164.68
		35,387.96
		257,552.64
Consolidated fund:		
Invested		151,666.00
Uninvested		8,161.18

CONDENSED STATEMENT OF RECEIPTS AND EXPENDITURES, 1916.

RECEIPTS.

Balance Jan. 1, 1916, as per last report	$15,147.15
Total income from investments	11,814.94
Bond transfer	2,040.00
Mortgage notes paid	15,000.00
Bonds called in	3,020.00
Annual dues:	
1914	
1915	
1916	735.00

[1] Full amount of capital invested as part of the consolidated fund.

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Interest on bank deposits	$251.31
William Ellery Hale lectureship	1,000.00
Contributions to Proceedings	2,178.33
Subscriptions to Proceedings	773.87
Reprints and separate numbers of Proceedings	525.15
Return of grant by A. H. Pfund to Gould fund	501.78
Deferred interest from Marsh estate	6,921.84
Return from Murray fund to general fund	.03
Return from Elliot fund to general fund	73.06
Transfers on account consolidated fund	3,394.81
Transfer Bache to Marsh fund (rectifying error)	472.50
Gift from Margaret Henderson Elliot	8,000.00
Gift to National Research Council	50.00
Receipt of income from consolidated fund	3,923.82
	75,823.59

EXPENDITURES.

Investment of capital		$16,800.00
Investment of income		1,913.75
Transfer of investments		2,040.00
Distribution income consolidated fund		3,923.82
Transfer income to capital		1,255.98
Transfer various funds to consolidated		2,136.18
Accrued interest		200.98
Payments from trust and other funds:		
Bache fund—		
J. P. Iddings	$1,000.00	
C. A. Kofoid	500.00	
R. A. Daly	1,000.00	
J. Voûte	401.00	
R. W. Hegner	160.00	
G. P. Baxter	300.00	
Louis T. Moore	500.00	
R. R. Reagan	100.00	
H. W. Norris	100.00	
A. F. Shull	100.00	
W. C. Allee	415.00	
Draper fund—		
Joel Stebbins	300.00	
Philip Fox	250.00	
Gibbs fund—		
G. P. Baxter	300.00	
Gould fund—		
Astronomical Journal	1,000.00	
E. B. Frost	40.00	
E. B. Frost	600.00	
Hale lectureship honorarium—		
H. F. Osborn	300.00	
Hartley medal—		
Cleveland Abbe, Gifford Pinchot	42.57	
Smith fund—		
S. A. Mitchell	300.00	

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Payments from trust and other funds—Continued.		
Watson fund—		
Mrs. A. H. Watson	$300.00	
J. A. Miller	370.00	
H. C. Wilson	300.00	
Watson medal, A. O. Leuschner	138.00	
Watson honorarium, A. O. Leuschner	100.00	
Transfer Bache to Marsh fund	472.50	
Elliot fund return to general fund	73.06	
Murray fund return to general fund	.03	
Marsh fund printing	2.65	
		9,464.81
Proceedings:		
Salary managing editor	750.00	
Printing and distributing	3,933.72	
Expenses office of editor	374.00	
Miscellaneous expenses	120.80	
		5,178.52
General fund:		
Salary assistant secretary and treasurer	600.00	
Treasurer's office	214.46	
Home secretary's office	710.39	
Foreign secretary's office	25.26	
Memoirs, printing, etc	277.75	
Meetings, annual	830.52	
Meetings, autumn	319.20	
Postage and telegrams	141.29	
Election of members	118.00	
International Association of Academies	34.35	
Panama Canal slide committee	86.69	
		3,357.91
		46,271.95
Cash balance Dec. 31, 1916:[1]		
Cash income balance		19,219.21
Uninvested capital		10,332.43
		75,823.59

Unpaid dues: 1916, $95.

[1] Three outstanding checks, $82.25.

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ACCOUNTS WITH INDIVIDUAL FUNDS JAN. 1 TO DEC. 31, 1916.

	General fund.		Building fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1916:				
Cash	$2,139.95		$391.53	$1,510.00
Invested	4,700.00		1,562.50	5,490.00
Receipts:				
Interest on investments	2,237.95		349.88	
Murray fund return	.03			
Elliot fund return	73.06			
Transfer income to capital				2,292.53
Total	9,150.99		2,303.91	9,292.53
Disbursements:				
General expenses	3,298.03		11.38	
Depreciation valuation bonds				338.50
Advance to Elliot fund	73.06			
Panama committee expenses	86.69			
Transfer income to capital			2,292.53	
Balance Dec. 31, 1916:				
Cash	1,006.96			
Invested	4,686.25			8,954.03
Total	9,150.99		2,303.91	9,292.53
Investments made	996.25			1,835.00

	Agassiz fund.		Bache fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1916:				
Cash		$100.00	$3,832.57	$82.05
Invested		49,900.00	2,575.00	55,917.95
Receipts:				
Interest on investments			2,466.73	
Transfer income to capital		25.00		351.45
Total		50,025.00	8,874.30	56,351.45
Disbursements:				
Depreciation valuation bonds		25.00		351.45
Warrant			4,576.00	
Transfer Bache to Marsh			472.50	
Transfer income to capital			351.45	
Balance Dec. 31, 1916:				
Cash			899.35	
Invested (including transfers to consolidated fund)		50,000.00	2,575.00	56,000.00
Total		50,025.00	8,874.30	56,351.45

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Accounts with individual funds Jan. 1 to Dec. 31, 1916—Continued.

	Comstock fund.		Draper fund.	
	Income.	Capital.	Income.	Capital.
Balance, Jan. 1, 1916:				
Cash	$708.82	$22.50	$1,247.06	.....
Invested	677.50	11,315.00	1,035.00	$10,000.00
Receipts:				
Interest on investments	588.50	.....	471.33	.....
Total	1,974.82	11,337.50	2,753.39	10,000.00
Disbursements:				
General expenses	.....	.....	5.70	.....
Warrants	.....	.....	550.00	.....
Balance, Dec. 31, 1916:				
Cash	1,297.32	22.50	245.19	.....
Invested	677.50	11,315.00	1,952.50	10,000.00
Total	1,974.82	11,337.50	2,753.39	10,000.00
Investments made	.....	.....	917.50	.....

	Elliot fund.		Gibbs fund.	
	Income.	Capital.	Income.	Capital.
Balance, Jan. 1, 1916:				
Cash	.....	.....	$345.77	$42.50
Invested	.....	.....	.....	5,457.50
Receipts:				
Interest on investments	$229.71	.....	226.48	.....
Margaret Henderson Elliot	.....	$8,000.00	.....	.....
Increase in value of bonds	.....	.....	.....	45.50
Total	229.71	8,000.00	572.25	5,545.50
Disbursements:				
General expenses	41.67	.....	.....	.....
Warrants	.....	.....	300.00	.....
Elliot fund return	73.06	.....	.....	.....
Balance, Dec. 31, 1916:				
Cash	114.98	.....	272.25	.....
Invested	.....	8,000.00	.....	5,545.50
Total	229.71	8,000.00	572.25	5,545.50

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Accounts with individual funds Jan. 1 to Dec. 31, 1916—Continued.

	Gould fund.		Marsh fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1916:				
Cash	$859.65	$46.25	$271.88	$750.00
Invested	4,057.50	19,953.75	677.50	9,377.65
Receipts:				
Interest on investments	1,227.49		368.38	
Grant A. H. Pfund returned	501.78			
Estate of O. C. Marsh			6,921.84	
Return interest, Bache to Marsh			472.50	
Transfer income to capital				2.65
Total	6,646.42	20,000.00	8,712.10	10,130.30
Disbursements:				
General expenses	9.86			
Warrants	1,640.00			
Income to capital			2.65	
Capital to consolidated				2.65
Balance Dec. 31, 1916:				
Cash	929.06	2,036.25	8,031.95	
Invested	4,067.50	17,963.75	677.50	10,127.65
Total	6,646.42	20,000.00	8,712.10	10,130.30
Transfer investment	1,020.00			
Investment made		1,010.00		
Investment paid	1,000.00			
Mortgage paid		2,000.00		

	Murray fund.		National research council.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1916:				
Cash		$35.00		
Invested		5,965.00		
Receipts:				
Interest on investments	$275.00			
Contribution national research council			$50.00	
Total	275.00	6,000.00	50.00	
Disbursements:				
General expenses	.03			
Balance Dec. 31, 1916:				
Cash	274.97	35.00	50.00	
Invested		5,965.00		
Total	275.00	6,000.00	50.00	

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Accounts with individual funds Jan. 1 to Dec. 31, 1916—Continued.

	Smith fund.		Watson fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1916:				
Cash	$762.27	$105.00	$92.65	$77.50
Invested	1,532.50	9,895.00	1,020.00	24,922.50
Receipts:				
Interest on investments	469.11		1,271.50	
Income to capital		90.00		
Total	2,763.88	10,090.00	2,384.15	25,000.00
Disbursements:				
General expenses			3.00	
Watson medal			135.00	
Watson honorarium			100.00	
Warrants	300.00		970.00	
Hartley income to capital	90.00			
Transfer to consolidated		90.00		
Balance Dec. 31, 1916:				
Cash	841.38		1,176.15	77.50
Invested	1,532.50	10,000.00		24,922.50
Total	2,763.88	10,090.00	2,384.15	25,000.00
Investment transferred			1,020.00	

	Proceedings.		Hale Lectureship.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1916:				
Cash	$1,128.70		$300.00	
Invested	1,020.00			
Receipts:				
Interest on investments	45.84			
Contribution to Hale Lectureship			1,000.00	
Reprints	506.65			
Separate numbers	18.50			
Contributions to proceedings	2,178.33			
Subscriptions	773.87			
Annual dues	735.00			
Total	6,406.89		1,300.00	
Disbursements:				
General expenses	5,178.52			
Hale Lectureship honorarium			300.00	
Balance Dec. 31, 1916:				
Cash	1,228.37		1,000.00	
Invested				
Total	6,406.89		1,300.00	
Investment transferred	1,020.00			

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Accounts with individual funds Jan. 1 to Dec. 31, 1916—Continued.

	Hartley fund.		Consolidated fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1916:				
Cash	$147.50	$148.00		
Invested		1,020.00		
Receipts:				
Interest on investments	38.55		$5,723.62	
Hartley income to capital		32.00		
Income to capital		2.50		
Total	186.05	1,202.50	5,723.62	
Disbursements:				
General expenses			57.50	
Hartley medal	42.57			
Hartley income to capital	34.50			
Distribution of consolidated interest			3,917.60	
Advance to building fund			6.22	
Transfer to consolidated		2.50		
Balance Dec. 31, 1916:				
Cash	108.98		1,742.30	$8,161.18
Invested		1,200.00		155,671.00
Total	186.05	1,202.50	5,723.62	163,832.18
Investments transferred			1,020.00	
Investments made				5,980.00
Mortgage paid				13,000.00

WHITMAN CROSS,
Treasurer.

JANUARY 2, 1917.

88121°—S. Doc. 707, 64-2——5

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REPORT OF THE AUDITING COMMITTEE.

WASHINGTON, D. C., *January 13, 1917.*

We hereby certify that we have examined the securities and papers contained in the box of the National Academy of Sciences at the American Security & Trust Co.'s building and have found them to correspond with the list checked by the auditing committee on January 14, 1916.

We find that the coupons due in 1916 have been cut and are accounted for; also that the coupons due January 1, 1917, have been detached and are accounted for by an appropriate entry in the pass book. We have accepted the certified statement of the Capital Audit Co. as to the correspondence between the vouchers, pass book, and accounts of the treasurer and as to the balance shown by the books of the treasurer on December 31, 1916, and certify to its agreement with the balance shown by the report of the treasurer, by his check book, and by the American Security & Trust Co.

W. H. DALL, *Chairman.*
ARTHUR L. DAY,
F. W. CLARKE.

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APPENDIXES.

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APPENDIX A.

CONSTITUTION OF THE NATIONAL ACADEMY.

As amended and adopted April 17, 1872, and further amended April 20, 1875; April 21, 1881; April 19, 1882; April 18, 1883; April 19, 1888; April 18, 1895; April 20, 1899; April 17, 1902; April 18, 1906; November 20, 1906; April 17, 1907; November 20, 1907; April 20, 1911; April 16, 1912; April 21, 1915.

PREAMBLE.

Empowered by the act of incorporation enacted by Congress, and approved by the President of the United States on the 3d day of March, A. D. 1863, and in conformity with amendments to said act approved July 14, 1870, June 20, 1884, and May 27, 1914, the National Academy of Sciences adopts the following amended constitution and rules:

ARTICLE I.—OF MEMBERS.

SECTION 1. The academy shall consist of members, honorary members, and foreign associates. Members must be citizens of the United States.

SEC. 2. Members who, from age or inability to attend the meetings of the academy, wish to resign the duties of active membership, may, at their own request, be transferred to the roll of honorary members by a vote of the academy.

SEC. 3. The academy may elect 50 foreign associates.

SEC. 4. Honorary members and foreign associates shall have the privilege of attending the meetings and of reading and communicating papers to the academy, but shall take no part in its business, shall not be subject to its assessments, and shall be entitled to a copy of the publications of the academy.

ARTICLE II.—OF THE OFFICERS.

SECTION 1. The officers of the academy shall be a president, a vice president, a foreign secretary, a home secretary, and a treasurer, all of whom shall be elected for a term of six years, by a majority of votes present, at the first stated meeting after the expiration of the current terms, provided that existing officers retain their places until their successors are elected. In case of a vacancy, the election for six years shall be held in the same manner at the meeting when such

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vacancy occurs, or at the next stated meeting thereafter, as the academy may direct. A vacancy in the office of treasurer or home secretary may, however, be filled by appointment of the president of the academy until the next stated meeting of the academy.

SEC. 2. The officers of the academy, together with six members to be elected by the academy, shall constitute a council for the transaction of such business as may be assigned to them by the constitution or the academy.

SEC. 3. The president of the academy, or, in case of his absence or inability to act, the vice president, shall preside at the meetings of the academy and of the council; shall name all committees except such as are otherwise especially provided for; shall refer investigations required by the Government of the United States to members especially conversant with the subjects and report thereon to the academy at its meeting next ensuing; and, with the council, shall direct the general business of the academy.

It shall be competent for the president, in special cases, to call in the aid, upon committees, of experts or men of special attainments not members of the academy.

The president shall be, *ex officio*, a member of all committees empowered to consider questions referred to the academy by the Government of the United States.

SEC. 4. The foreign and home secretaries shall conduct the correspondence proper to their respective departments, advising with the president and council in cases of doubt, and reporting their action to the academy at one of the stated meetings in each year.

It shall be the duty of the home secretary to give notice to the members of the place and time of all meetings, of all nominations for membership, and of all proposed amendments to the constitution.

It shall be the duty of the home secretary to keep the minutes of each business and scientific session, and after approval to enter these upon the permanent records of the academy.

SEC. 5. The treasurer shall attend to all receipts and disbursements of the academy, giving such bond and furnishing such vouchers as the council may require. He shall collect all dues, assessments, and subscriptions, and keep a set of books showing a full account of receipts and disbursements and the condition of all funds of the academy. He shall be the custodian of the corporate seal of the academy.

ARTICLE III.—OF THE MEETINGS.

SECTION 1. The academy shall hold one stated meeting in each year, called the annual meeting, in the city of Washington, beginning on the third Monday in April, and another, called the autumn meeting, to be held at such place and time as the council shall determine.

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Special business meetings of the academy may be called, by order of eight members of the council, at such place and time as may be designated in the call.

Special scientific meetings of the academy may be held at times and places to be designated by a majority of the council.

SEC. 2. The names of the members present at each session of a meeting shall be recorded in the minutes, and the members present at any session shall constitute a quorum for the transaction of business.

SEC. 3. Scientific sessions of the academy, unless otherwise ordered by a majority of the members present, shall be open to the public; sessions for the transaction of business shall be closed.

SEC. 4. Stated meetings of the council shall be held during the stated or special meetings of the academy and four members shall constitute a quorum for the transaction of business. Special meetings of the council may be convened at the call of the president and two members of the council, or of four members of the council.

SEC. 5. No member whose dues are in arrears shall vote at any business meeting of the academy.

ARTICLE IV.—OF ELECTIONS AND RESIGNATIONS.

SECTION 1. All elections of officers and members shall be by ballot, and each election shall be held separately.

SEC. 2. The time for holding an election of officers shall be fixed by the academy at least one day before the election is held.

SEC. 3. The election of the six members of the council shall be as follows:

At the annual meeting in April, 1907, six members of the council to be elected, of whom two shall serve for three years, two for two years, and two for one year, their respective terms to be determined by lot. Each year thereafter the terms of two members shall expire, and their successors, to serve for three years, shall be elected at the annual meeting in each year.

SEC. 4. The academy shall be divided by the council into sections representing the principal branches of scientific research. Each section shall elect its own chairman, who shall serve for three years. The chairman shall be responsible to the academy for the work of his section.

Nominations to membership in the academy shall be made in writing and approved by a majority of the members of the section on the branch of research in which the person nominated is eminent, or by a majority of the council in case there is no section on the subject. The nominations shall be sent to the home secretary by the chairman of the section before January 1 of the year in which the election is to be held, and each nomination shall be accompanied by a list of

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the principal contributions of the nominee to science. This list shall be printed by the home secretary for distribution among the members of the academy.

SEC. 5. Election of members shall be held at the annual meeting in Washington in the following manner: There shall be two ballots—a preference ballot, which may be prepared either before or at the annual meeting and must be transmitted to the home secretary, and a final ballot, to be taken at the meeting.

Preference ballot.—Each member may inscribe on a ballot not more than 15 names of nominees selected from the submitted list. A list of the nominees shall then be prepared, on which the names shall be entered in the order of the number of votes received by each. In case two or more nominees have the same number of votes on this preference list, the order in which they shall be placed on the list shall be determined by a majority vote of members present.

Final ballot.—A vote shall first be taken on the nominee who appears first on the preference list, and he shall be declared elected if he receive two-thirds of the votes cast and not less than 25 votes in all. A vote shall then be taken in similar manner on the nominee standing second on the preference list, and so on until all the nominees on the preference list shall have been acted on, or until 15 nominees shall have been elected or until the total membership of the academy shall have reached 250.

Not more than 15 members shall be elected at one annual meeting.

Before and during elections a discussion of the merits of nominees will be in order.

SEC. 6. Every member-elect shall accept his membership, personally or in writing, before the close of the next stated meeting after the date of his election. Otherwise, on proof that the secretary has formally notified him of his election, his name shall not be entered on the roll of members.

SEC. 7. Foreign associates may be nominated by the council and may be elected at the annual meeting by a two-thirds vote of the members present.

SEC. 8. A diploma, with the corporate seal of the academy and the signatures of the officers, shall be sent by the appropriate secretary to each member on his acceptance of membership, and to foreign associates on their election.

SEC. 9. Resignations shall be addressed to the president and acted on by the academy.

SEC. 10. Whenever a member has not paid his dues for four successive years, the treasurer shall report the fact to the council, which may report the case to the academy with the recommendation that the person thus in arrears be declared to have forfeited his membership. If this recommendation be approved by two-thirds of the members

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present, the said person shall no longer be a member of the academy and his name shall be dropped from the roll.

ARTICLE V.—SCIENTIFIC COMMUNICATIONS, PUBLICATIONS, AND REPORTS.

SECTION 1. Communications on scientific subjects shall be read at scientific sessions of the academy, and papers by any member may be read by the author or by any other member, notice of the same having been previously given to the secretary.

SEC. 2. Any member of the academy may read a paper from a person who is not a member, and shall not be considered responsible for the facts or opinions expressed by the author, but shall be held responsible for the propriety of the paper.

Persons who are not members may read papers on invitation of the council or of the committee of arrangements.

SEC. 3. The academy may provide for the publication, under the direction of the council, of proceedings, scientific memoirs, biographical memoirs, and reports.

The proceedings shall include the transactions of the academy, brief original announcements of the results of scientific investigations made by members of the academy or others, together with short original articles giving a comprehensive survey of the more important scientific researches currently made by American investigators, and other matters of general scientific interest.

The scientific memoirs shall provide opportunity for the publication of longer and more detailed scientific investigations.

The biographical memoirs shall contain an appropriate record of the life and work of deceased members of the academy.

An annual report shall be presented to Congress by the president and shall contain the annual reports of the treasurer and the auditing committee, a suitable summary of the reports of the committees in charge of trust funds, and a record of the activities of the academy for the calendar year immediately preceding, and other appropriate matter. This report shall be presented to Congress by the president after authorization by the council. It shall also be presented to the academy at the annual meeting next following.

The treasurer shall prepare a full report of the financial affairs of the academy at the end of the fiscal year. This report shall be submitted to the council for approval and afterwards presented to the academy at the annual meeting.

SEC. 4. Propositions for investigations or reports by the academy shall be submitted to the council for approval, except those requested by the Government of the United States, which shall be acted on by the president, who will in such cases report their results to the Government as soon as obtained and to the academy at its next following stated meeting.

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SEC. 5. The advice of the academy shall be at all times at the disposition of the Government upon any matter of science or art within its scope.

ARTICLE VI.—OF THE PROPERTY OF THE ACADEMY.

SECTION 1. All investments and reinvestments of either principal or accumulations of income of the trust and other funds of the academy shall be made by the treasurer, with the approval of the finance committee, in the corporate name of the academy, in the manner and in the securities designated or specified in the instruments creating the several funds, or, in the absence of such designation or specification, in bonds of the United States or of the several States, or in bonds or notes secured by first mortgages on real estate, in investments legal for savings banks under the laws of Massachusetts or New York, or in other bonds recommended to the treasurer by the fiscal advisers of the academy.

The treasurer may invest the capital of all trust funds of the academy which are not required by the instruments creating such funds to be kept separate and distinct, in a consolidated fund, and shall apportion the income received from such consolidated fund among the various funds composing the same in the proportion that each of said funds shall bear to the total amount of funds so invested; provided, however, that the treasurer shall at all times keep accurate accounts showing the amount of each trust fund, the proportion of the income from the consolidated fund to which it is entitled, and the expenses and disbursements properly chargeable to such fund.

SEC. 2. The council shall at its annual meeting in each year designate one bank or trust company in Washington, D. C., and one in New York City, to act, when requested by the treasurer, as the fiscal advisers of the academy.

SEC. 3. The treasurer shall have authority, with the approval of the finance committee, to sell, transfer, convey, and deliver in the corporate name and for the benefit of the academy any stocks, bonds, or other securities standing in the corporate name.

SEC. 4. No contract shall be binding upon the academy which has not been first approved by the council.

SEC. 5. The assessments required for the support of the academy shall be fixed by the academy on the recommendation of the council and shall be payable within the calendar year for which they are assessed.

ARTICLE VII.—OF TRUST FUNDS AND THEIR ADMINISTRATION.

SECTION 1. Devises, bequests, donations, or gifts having for their object the promotion of science or the welfare of the academy may be accepted by the council for the academy. Before the acceptance

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of any such trust the council shall consider the object of the trust and all conditions or specifications attaching thereto. The council shall make a report of its action to the academy.

SEC. 2. Medals and prizes may be established in accordance with the provisions of trusts or by action of the academy.

SEC. 3. Unless otherwise provided by the deed of gift, the income of each trust fund shall be applied to the objects of that trust by the action of the academy on the recommendation of a standing committee on that fund.

ARTICLE VIII.—OF ADDITIONS AND AMENDMENTS.

Additions and amendments to the constitution shall be made only at a stated meeting of the academy. Notice of a proposition for such a change must be submitted to the council, which may amend the proposition, and shall report thereon to the academy. Its report shall be considered by the academy in committee of the whole for amendment.

The proposition as amended, if adopted in committee of the whole, shall be voted on at the next stated meeting, and if it receives two-thirds of the votes cast it shall be declared adopted.

Absent members may send their votes on pending changes in the constitution to the home secretary in writing, and such votes shall be counted as if the members were present.

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APPENDIX B.

RULES.

(In accordance with a resolution of the academy, taken at its meeting on April 21, 1915, the rules are arranged in groups and each group is numbered to correspond with the article of the constitution to which it relates.)

I.

1. The holders of the medal for eminence in the application of science to the public welfare shall be notified, like members, of the meetings of the academy, and invited to participate in its scientific sessions.

II.

1. The proper secretary shall acknowledge all donations made to the academy, and shall at once report them to the council for its consideration.

2. The home secretary shall be the custodian of all books, apparatus, archives, and collections not explicitly assigned to other care.

3. The home secretary shall keep a record of all grants of money or awards of prizes or medals made from trust funds of the academy. The record for each grant of money shall include the following items:

1. Name of fund.
2. Date and number of the grant.
3. Name and address of recipient.
4. Amount of grant and date or dates of payment.
5. Purpose of grant.
6. Record or report of progress.
7. Resulting publications.

4. The treasurer shall keep the home secretary informed of all warrants received from directors of trust funds not controlled by the academy and of the date or dates of payment of all warrants.

5. The treasurer is authorized to defray, when approved by the president, all the proper expenses of committees appointed to make scientific investigations at the request of departments of the Government, and in each case to look to the department requesting the investigation for reimbursement to the academy.

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III.

1. At the business sessions of the academy the order of procedure shall be as follows:

1. Chair taken by the president, or, in his absence, by the vice president.

2. Roll of members called by home secretary (first session of the meeting only).

3. Minutes of the preceding session read and approved.

4. Stated business.

5. Reports of president, secretaries, treasurer, and committees.

6. Business from council.

7. Other business.

2. The rules of order of the academy shall be those of the Senate of the United States, unless otherwise provided by the constitution or rules of the academy.

3. In the absence of any officer a member shall be chosen to perform his duties temporarily, by a plurality of *viva voce* votes, upon open nomination.

4. At each meeting the president shall announce the death of any members since the preceding meeting. As soon as practicable thereafter he shall designate a member to write—or to secure from some other source approved by the president—a biographical notice of each deceased member.

5. A standing committee of three members called the program committee, a local committee of five members appointed for each meeting, and the home secretary shall together constitute the committee of arrangements, of which the home secretary shall be chairman.

The term of service on the program committee shall be three years, one member retiring annually, the chairman to be designated by the president.

It shall be the duty of the program committee to prepare the scientific program for the annual meeting, and for this purpose it shall be empowered to solicit papers from members or others. It shall also be empowered to ascertain the length of time required for reading papers to be presented at the scientific sessions of the academy, and, when it appears advisable, to limit the time to be occupied in their presentation or discussion.

The local committee shall meet not less than two months previous to each meeting. It shall prepare the detailed program of each day, and in general shall have charge of all business and scientific arrangements for the meeting for which it is appointed except those specifically assigned to the program committee in the case of the annual meeting.

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IV.

1. The term of service of each chairman of a section shall be three years, to date from the closing session of the April meeting next following his election. Chairmen of sections shall be chosen by mail ballot, the member receiving the highest number of votes cast to be deemed elected. It shall be the duty of each retiring chairman to conduct the election of his successor and to report the result of the election to the home secretary before the April meeting at which his term of service expires. Should any section fail to elect a chairman before November 1, the president is empowered to appoint a temporary chairman to serve until the April meeting next following. No chairman shall be eligible for reelection for two consecutive terms.

2. The chairman of each section of the academy shall submit to the members of his section, not later than November 1 of each year, a ballot containing the names of all those persons who received not less than two votes in the nominating ballot of the preceding year and of any other persons who were newly proposed for consideration at that time. Each member of the section shall be expected to return this ballot to the chairman within two weeks with his signature and with crosses placed against the names of those persons whom he is prepared to endorse for nomination. Each member may also write upon the ballot in a place provided for the purpose any new names which he desires to have included in the ballot to be submitted to the section in the following year. The vote resulting from this ballot shall be regarded as informal.

The chairman shall then submit to the members of his section a new ballot showing the results of the informal vote; and each member shall be expected to return this ballot to the chairman with his signature and with crosses placed against the names of those persons whom he will endorse for nomination. In order to secure an adequate number of nominations, the chairman, when necessary, shall obtain by personal solicitation a fuller vote of his section or shall submit to the section a supplementary formal ballot.

The chairman shall then certify to the home secretary, prior to January 1, the names of those persons who have been voted for on the formal ballots by a majority of the members of the section, and shall furnish him a list of the publications of these nominees, as required by the constitution.

3. Nominations for membership shall give the full name, residence, and the official positions successively held by the candidate, in addition to the list of his contributions to science required by the constitution.

4. Preference ballots for election of members shall be sealed in a blank envelope, which shall be inclosed in another bearing the name

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of the sender, and which shall be addressed to the home secretary. Such envelopes shall be opened only by the tellers. If in any case the tellers are unable to determine who cast a ballot, or if the latter contains more names than are to be voted for, the ballot shall be rejected, but minor defects in a ballot shall be disregarded when the intent of the voter is obvious.

5. All discussions of the claims and qualifications of nominees at meetings of the academy shall be held strictly confidential, and remarks and criticisms then made may be communicated to no person who was not a member of the academy at the time of the discussion.

V.

1. The publication of the proceedings shall be under the general charge of the council, which shall have final jurisdiction upon all questions of policy relating thereto. The preparation of the proceedings for publication shall be entrusted to an editorial board. This board shall consist of a chairman and a managing editor, both of whom shall be appointed by the council for definite terms of service; of the home secretary and foreign secretary *ex officiis*, and of a body of associate editors representing the various branches of science which are to be included in the scope of the proceedings. The managing editor, who may be a nonmember of the academy, shall receive a salary, which shall be fixed by the council. It shall be the duty of the managing editor to prepare the proceedings in detail for publication; but the chairman of the editorial board shall decide, in consultation with the managing editor, in regard to the acceptance, rejection, or substantial modification of papers offered for publication. The associate editors shall be appointed by the council, upon recommendation of the chairman of the editorial board, for a period of three years, one-third of them retiring annually. The home secretary and the foreign secretary shall be responsible for the distribution of the proceedings in their respective fields.

2. Memoirs may be presented at any time to the home secretary, who shall report the date of their reception at the next session; but no memoir shall be published unless it has been read or presented by title before the academy.

Before publication all biographical and scientific memoirs must be referred to the committee on publication, who may, if they deem best, refer any memoir to a special committee appointed by the president to determine whether the same should be published by the academy.

3. Memoirs shall date, in the records of the academy, from the date of their presentation to the academy, and the order of their presentation shall be so arranged by the secretary that, so far as may be convenient, those upon kindred topics shall follow one another.

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4. The annual report of the treasurer shall contain:

1. A concise statement of the source, object, and amount of all trust funds of the academy.
2. A condensed statement of receipts and expenditures.
3. A statement of assets and liabilities.
4. Accounts with individual funds.
5. Such other matter as he considers appropriate.

5. The accounts of the treasurer shall, between January 1 and January 15 of each year, be audited by a committee of three members to be appointed by the president at the autumn meeting of the academy. It shall be the duty of the auditing committee to verify the record of receipts and disbursements maintained by the treasurer and the agreement of book and bank balances; to examine all securities in the custody of the treasurer and to compare the stated income of such securities with the receipts of record; to examine all vouchers covering disbursements for account of the academy and the authority therefor and to compare them with the treasurer's record of expenditures; to examine and verify the account of the academy with each trust fund. The auditing committee may employ an expert accountant to assist the committee in the examination of the books of the treasurer. The annual report of the treasurer shall be published with that of the president to Congress. The reports of the treasurer and auditing committee shall be presented to the academy at the annual meeting.

VI.

1. All apparatus and other materials of permanent value purchased with money from any grant from a trust fund shall be the property of the academy unless specific exception is made in the grant or by subsequent action of the council or the directors of the trust fund concerned. Receipts for all such property shall be signed by the grantee and shall be forwarded to the home secretary. All apparatus and unused material of value acquired in this way shall be delivered to the home secretary on completion of the investigation for which the grant was made, or at any time on demand of the council, and the home secretary shall give an appropriate release therefor.

2. The books, apparatus, archives, and other collections of the academy shall be deposited in some safe place in the city of Washington. A list of the articles so deposited shall be kept by the home secretary, who is authorized to employ a clerk to take charge of them.

3. A stamp corresponding to the corporate seal of the academy shall be kept by the secretaries, who shall be responsible for the due marking of all books and other objects to which it is applicable.

Labels or other proper marks of similar device shall be placed upon objects not admitting of the stamp.

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4. The fiscal year of the academy shall end on December 31 of each year.

5. The standing committee on finance shall consist of the treasurer *ex officio* as chairman and two members to be appointed annually by the president.

VII.

1. Standing committees of the academy on trust funds the income of which is applied to the promotion of research shall consist of three or five members. In order to secure rotation in office in such committees, when not in conflict with the provisions of the deeds of gift, the term of service on a committee of three members shall be three years; on a committee of five members the term shall be five years.

2. The annual reports of the committees on research funds shall, so far as the academy has authority to determine their form, give a current number to each award, stating the name, position, and address of the recipient, the subject of research for which the award is made, and the sum awarded; and in later annual reports the status of the work accomplished under each award previously made shall be announced, until the research is completed, when announcement of its completion and, if published, the title and place of publication shall be stated, and the record of the award shall be reported as closed.

VIII.

1. Any rule of the academy may be amended, suspended, or repealed on the written motion of any two members, signed by them, and presented at a stated meeting of the academy, provided the same shall be approved by a majority of the members present.

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APPENDIX C.

ORGANIZATION OF THE ACADEMY, 1916–17.

	Expiration of term.
WELCH, WILLIAM H., *President*	April, 1919
WALCOTT, CHARLES D., *Vice-President*	April, 1919
HALE, GEORGE E., *Foreign Secretary*	April, 1922
DAY, ARTHUR L., *Home Secretary*	April, 1919
CROSS, WHITMAN, *Treasurer*	April, 1917

ADDITIONAL MEMBERS OF COUNCIL.

1914–1917.

CONKLIN, E. G. — NOYES, A. A.

1915–1918.

COULTER, J. M. — HOWELL, W. H.

1916–1919.

CHITTENDEN, R. H. — PUPIN, M. I.

SECTIONS.

1. MATHEMATICS.

BLISS, G. A.
BÔCHER, MAXIME
BOLZA, OSKAR
DICKSON, L. E.
MOORE, E. H.
OSGOOD, W. F.
STORY, W. E.
VAN VLECK, E. B. (*Chairman, 1916–1919*)
WHITE, H. S.

2. ASTRONOMY.

ABBOT, C. G.
BARNARD, E. E.
CAMPBELL, W. W.
COMSTOCK, G. C.
ELKIN, W. L.
FROST, E. B.
HALE, G. E.
LEUSCHNER, A. O.
MOULTON, F. R.
PICKERING, E. C. (*Chairman, 1916–1919*)
SCHLESINGER, FRANK

3. PHYSICS.

ABBOT, H. L.
AMES, J. S.
BARUS, CARL
BELL, A. G.
BUMSTEAD, H. A.
CREW, HENRY
HALL, E. H.
HASTINGS, C. S.
HAYFORD, J. F.
MENDENHALL, T. C.
MERRITT, ERNEST
MICHELSON, A. A.
MILLIKAN, R. A.
NICHOLS, E. F. (*Chairman, 1916–1919*)
NICHOLS, E. L.
PUPIN, M. I.
ROSA, E. B.
THOMSON, ELIHU
TROWBRIDGE, JOHN
WEBSTER, A. G.
WOOD, R. W.
WOODWARD, R. S.

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4. CHEMISTRY.

BAXTER, G. P.
BOGERT, M. T.
BOLTWOOD, B. B.
CHANDLER, C. F.
CLARKE, F. W.
CRAFTS, J. M.
FRANKLIN, E. C.
GOMBERG, MOSES
GOOCH, F. A.
HILLEBRAND, W. F.
JACKSON, C. L.
LEWIS, G. N.
MICHAEL, ARTHUR
MORLEY, E. W.
MORSE, H. N.
NOYES, A. A.
NOYES, W. A.
OSBORNE, T. B.
REMSEN, IRA
RICHARDS, T. W. (*Chairman, 1916–1919*)
SMITH, ALEXANDER
SMITH, EDGAR F.
STIEGLITZ, JULIUS
WELLS, H. L.

5. GEOLOGY AND PALEONTOLOGY.

BECKER, G. F.
BRANNER, J. C.
CHAMBERLIN, T. C.
CLARK, W. B. (*Chairman, 1916–1919*)
CLARKE, J. M.
CROSS, WHITMAN
DALL, W. H.
DANA, E. S.
DAVIS, W. M.
DAY, A. L.
GILBERT, G. K.
HAGUE, ARNOLD
IDDINGS, J. P.
KEMP, J. F.
LINDGREN, WALDEMAR
OSBORN, H. F.
PIRSSON, L. V.
PUMPELLY, RAPHAEL
RANSOME, F. L.
REID, H. F.
SCHUCHERT, CHARLES
SCOTT, W. B.
VAN HISE, C. R.
WALCOTT, C. D.
WHITE, DAVID
WILLISTON, S. W.

6. BOTANY.

BRITTON, N. L.
CAMPBELL, D. H.
COULTER, J. M. (*Chairman, 1915–1918*)
FARLOW, W. G.
GOODALE, G. L.
HARPER, R. A.
SARGENT, C. S.
SMITH, ERWIN F.
THAXTER, ROLAND
TRELEASE, WILLIAM

7. ZOOLOGY AND ANIMAL MORPHOLOGY.

ALLEN, J. A.
CASTLE, W. E.
CONKLIN, E. G.
DAVENPORT, C. B.
DONALDSON, H. H.
HARRISON, R. G.
HOWARD, L. O.
JENNINGS, H. S.
LILLIE, F. R.
MALL, F. P.
MARK, E. L.
MAYER, A. G.
MERRIAM, C. H.
MORGAN, T. H.
MORSE, E. S.
PARKER, G. H. (*Chairman, 1916–1919*)
VERRILL, A. E.
WHEELER, W. M.
WILSON, EDMUND B.

8. PHYSIOLOGY AND PATHOLOGY.

ABEL, J. J.
BENEDICT, F. G.
CANNON, W. B.
CHITTENDEN, R. H.
COUNCILMAN, W. T.
FLEXNER, SIMON
FOLIN, OTTO
HOWELL, W. H. (*Chairman, 1916–1919*)
LEVENE, P. A. T.
LOEB, JACQUES
LUSK, GRAHAM
MELTZER, S. J.
MENDEL, L. B.
PEARL, RAYMOND
PRUDDEN, T. M.
SMITH, THEOBALD
VAUGHAN, V. C.
WELCH, W. H.
WOOD, H. C.

9. ANTHROPOLOGY AND PSYCHOLOGY.

BOAS, FRANZ
CATTELL, J. McK. (*Chairman, 1916–1919*)
DEWEY, JOHN
FEWKES, J. W.
HALL, G. S.
HOLMES, W. H.

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STANDING COMMITTEES.

ON WEIGHTS, MEASURES, AND COINAGE.

MENDENHALL, T. C. (*Chairman*) MICHELSON, A. A. MORLEY, E. W.
WEBSTER, A. G. WOODWARD, R. S.

ON SOLAR RESEARCH.

HALE, G. E. (*Chairman*) CAMPBELL, W. W. MICHELSON, A. A.
NICHOLS, E. L. PICKERING, E. C.

ON PUBLICATION.

The PRESIDENT. The HOME SECRETARY. WALCOTT, C. D.

EDITORIAL BOARD OF THE PROCEEDINGS.

PEARL, RAYMOND (*Chairman*) WILSON, EDWIN B. (*Managing Editor*)
DAY, A. L. (*Home Secretary*) HALE, G. E. (*Foreign Secretary*)

ABEL, J. J., 1918.	FROST, E. B., 1917.	MAYER, A. G., 1919.
CLARKE, J. M., 1918.	HARPER, R. A., 1919.	MILLIKAN, R. A., 1918.
CONKLIN, E. G., 1917.	HOLMES, W. H., 1917.	MOORE, E. H., 1917.
DAVENPORT, C. B., 1917.	IDDINGS, J. P., 1918.	NOYES, A. A., 1919.
DONALDSON, H. H., 1919.	LUSK, GRAHAM, 1919.	SMITH, ALEXANDER, 1918.

ON COLLECTION OF HISTORICAL PORTRAITS, MANUSCRIPTS, INSTRUMENTS, ETC.

WALCOTT, C. D. (*Chairman*) CLARKE, F. W. HAGUE, ARNOLD
HALE, G. E. MELTZER, S. J. PUPIN, M. I.

ON PROGRAM.

BOLTWOOD, B. B. (*Chairman*), 1918 CATTELL, J. McK., 1919
FROST, E. B., 1917.

FINANCE COMMITTEE.

CROSS, WHITMAN (*Chairman*) HAGUE, ARNOLD WALCOTT, C. D.

TRUST FUNDS.

THE BACHE FUND.

[$56,000.]

Researches in physical and natural science.

FROST, E. B. (*Chairman*) HARRISON, R. G. WEBSTER, A. G.

THE WATSON FUND.

[$25,000.]

Watson medal and the promotion of astronomical research.

FROST, E. B. (*Chairman*) COMSTOCK, G. C. ELKIN, W. L.

THE HENRY DRAPER FUND.

[$10,000.]

Draper medal and investigations in astronomical physics.

CAMPBELL, W. W. (*Chairman*), 1919. ABBOT, C. G., 1921. AMES, J. S., 1920.
HALE, G. E., 1918. MICHELSON, A. A., 1917.

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THE J. LAWRENCE SMITH FUND.

[$10,000.]

J. Lawrence Smith medal and investigations of meteoric bodies.

MORLEY, E. W. (*Chairman*), 1919. DANA, E. S., 1918. HAGUE, ARNOLD, 1917.
PICKERING, E. C., 1920. WOOD, R. W., 1921.

THE BARNARD MEDAL.[1]

Meritorious service to science.

WOODWARD, R. S. (*Chairman*) CAMPBELL, W. W. NICHOLS, E. F.
NOYES, A. A. RICHARDS, T. W.

THE BENJAMIN APTHORP GOULD FUND.

[$20,000.]

Researches in astronomy.

MOULTON, F. R. (*Chairman*) BARNARD, E. E. WOODWARD, R. S.

THE WOLCOTT GIBBS FUND.

[$5,545.50.]

Chemical research.

JACKSON, C. L. (*Chairman*) RICHARDS, T. W. SMITH, EDGAR F.

THE COMSTOCK FUND.

[$11,287.50.]

Researches in electricity, magnetism, and radiant energy.

NICHOLS, E. L. (*Chairman*), 1918. MILLIKAN, R. A., 1921. NOYES, A. A., 1919.
THOMSON, ELIHU, 1920. WEBSTER, A. G., 1917.

THE MARSH FUND.

[$10,127.65.]

Original research in the natural sciences.

MOORE, E. H. (*Chairman*), 1919. DANA, E. S., 1917.

SCHUCHERT, CHARLES, 1918.

THE AGASSIZ FUND.

[$50,000.]

General uses of the Academy.

THE MURRAY FUND.

[$6,000.]

Agassiz medal and contributions to oceanography.

DALL, W. H. (*Chairman*), 1918. DAVIS, W. M., 1919. PARKER, G. H., 1917.

THE MARCELLUS HARTLEY FUND.

[$1,200.]

Medal for eminence in the application of science to the public welfare.

BECKER, G. F. (*Chairman*), 1919. HILLEBRAND, W. F., 1919.
OSBORN, H. F., 1918. PUPIN, M. I., 1918. SMITH, THEOBALD, 1917.
WEBSTER, A. G., 1917.

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[1] Every five years the committee recommends the person whom they consider most deserving of the medal, and upon the approval of the Academy the name of the nominee is forwarded to the trustees of Columbia University, who administer the Barnard Medal Fund.

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THE JOSEPH HENRY FUND.

To assist meritorious investigators, especially in the direction of original research.

The sum of $40,000 was contributed by Fairman Rogers, Joseph Patterson, George W. Childs, and others, as an expression of their respect and esteem for Prof. Joseph Henry. This amount was deposited with the Pennsylvania Company for the Insurance of Lives and Granting Annuities in Trust, with authorization to collect the income thereon and to pay over the same to Prof. Joseph Henry during his natural life, and after his death to his wife and daughters, and after the death of the last survivor to "deliver the said fund and the securities in which it shall then be invested to the National Academy of Sciences, to be thenceforward forever held in trust under the name and title of the 'Joseph Henry Fund.'"

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MEMBERS OF THE NATIONAL ACADEMY OF SCIENCES.

DECEMBER 31, 1916.

		Date of election.
ABBOT, CHARLES GREELEY	*Smithsonian Institution, Washington, D. C.*	1915
ABBOT, HENRY L	*23 Berkeley St., Cambridge, Mass.*	1872
ABEL, JOHN JACOB	*Johns Hopkins University, Baltimore, Md.*	1912
ALLEN, J. ASAPH	*American Museum of Natural History, N. Y. City.*	1876
AMES, JOSEPH S	*Johns Hopkins University, Baltimore, Md.*	1909
BARNARD, E. E	*Yerkes Observatory, Williams Bay, Wis.*	1911
BARUS, CARL	*Brown University, Providence, R. I.*	1892
BAXTER, GREGORY PAUL	*T. J. Coolidge Jr. Mem. Lab., Cambridge, Mass.*	1916
BECKER, GEORGE F	*U. S. Geological Survey, Washington, D. C.*	1901
BELL, A. GRAHAM	*1331 Connecticut Ave., Washington, D. C.*	1883
BENEDICT, FRANCIS GANO	*Nutrition Laboratory, Boston, Mass.*	1914
BLISS, GILBERT AMES	*University of Chicago, Chicago, Ill.*	1916
BOAS, FRANZ	*Columbia University, New York City.*	1900
BOGERT, MARSTON TAYLOR	*Columbia University, New York City.*	1916
BÔCHER, MAXIME	*Harvard University, Cambridge, Mass.*	1909
BOLTWOOD, B. B	*Yale University, New Haven, Conn.*	1911
BOLZA, OSKAR	*Reichsgrafenstr. 10, Freiburg, Germany.*	1909
BRANNER, JOHN C	*Stanford University, California.*	1905
BRITTON, NATHANIEL LORD	*New York Botanical Gardens, N. Y. City.*	1914
BUMSTEAD, HENRY ANDREWS	*Yale University, New Haven, Conn.*	1913
CAMPBELL, D. H	*Stanford University, California.*	1910
CAMPBELL, WILLIAM W	*Lick Observatory, Mount Hamilton, California.*	1902
CANNON, WALTER BRADFORD	*Harvard University, Cambridge, Mass.*	1914
CASTLE, WILLIAM ERNEST	*186 Payson Road, Belmont, Mass.*	1915
CATTELL, JAMES MCK	*Garrison, N. Y.*	1901
CHAMBERLIN, THOMAS CHROWDER	*University of Chicago, Chicago, Ill.*	1903
CHANDLER, CHARLES F	*Columbia University, New York City.*	1874
CHITTENDEN, RUSSELL H	*Sheffield Scientific School, New Haven, Conn.*	1890
CLARK, WILLIAM BULLOCK	*Johns Hopkins University, Baltimore, Md.*	1908
CLARKE, F. W	*U. S. Geological Survey, Washington, D. C.*	1909
CLARKE, J. M	*State Hall, Albany, N. Y.*	1909
COMSTOCK, GEORGE C	*Washburn Observatory, Madison, Wis.*	1899
CONKLIN, E. G	*Princeton, N. J.*	1908
COULTER, J. M	*University of Chicago, Chicago, Ill.*	1909
COUNCILMAN, WILLIAM T	*Harvard Medical School, Boston, Mass.*	1904
CRAFTS, JAMES M	*19 Commonwealth Ave., Boston, Mass.*	1872
CREW, HENRY	*Northwestern University, Evanston, Ill.*	1909
CROSS, WHITMAN	*U. S. Geological Survey, Washington, D. C.*	1908
DALL, WILLIAM H	*Smithsonian Institution, Washington, D. C.*	1897
DANA, EDWARD S	*Yale University, New Haven, Conn.*	1884
DAVENPORT, CHARLES B	*Cold Spring Harbor, N. Y.*	1912
DAVIS, WILLIAM MORRIS	*31 Hawthorn St., Cambridge, Mass.*	1904
DAY, ARTHUR L	*Geophysical Laboratory, Washington, D. C.*	1911

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		Date of election.
DEWEY, JOHN	*Columbia University, New York City.*	1910
DICKSON, LEONARD E	*University of Chicago, Chicago, Ill.*	1913
DONALDSON, HENRY HERBERT	*Wistar Institute of Anatomy, Phila., Pa.*	1914
ELKIN, WILLIAM L	*Yale University Observatory, New Haven, Conn.*	1895
FARLOW, W. G	*Harvard University, Cambridge, Mass.*	1879
FEWKES, JESSE WALTER	*Bureau of American Ethnology, Wash., D. C.*	1914
FLEXNER, SIMON	*Rockefeller Institute, New York City.*	1908
FOLIN, OTTO	*Harvard Medical School, Boston, Mass.*	1916
FRANKLIN, EDWARD CURTIS	*Stanford University, California.*	1914
FROST, EDWIN B	*Yerkes Observatory, Williams Bay, Wis.*	1908
GILBERT, GROVE K	*U. S. Geological Survey, Washington, D. C.*	1883
GOMBERG, MOSES	*University of Michigan, Ann Arbor, Mich.*	1914
GOOCH, FRANK A	*Yale University, New Haven, Conn.*	1897
GOODALE, GEORGE L	*Harvard University, Cambridge, Mass.*	1890
HAGUE, ARNOLD	*U. S. Geological Survey, Washington, D. C.*	1885
HALE, GEORGE E	*Solar Observatory Office, Pasadena, Cal.*	1902
HALL, EDWIN H	*Harvard University, Cambridge, Mass.*	1911
HALL, GRANVILLE STANLEY	*Clark University, Worcester, Mass.*	1915
HARPER, R. A	*Columbia University, New York City.*	1911
HARRISON, ROSS G	*Yale University, New Haven, Conn.*	1913
HASTINGS, CHARLES S	*Yale University, New Haven, Conn.*	1889
HAYFORD, JOHN F	*Northwestern University, Evanston, Ill.*	1911
HILLEBRAND, WILLIAM F	*Bureau of Standards, Washington, D. C.*	1908
HOLMES, WILLIAM H	*U. S. National Museum, Washington, D. C.*	1905
HOWARD, LELAND OSSIAN	*U. S. Dept. of Agriculture, Washington, D. C.*	1916
HOWELL, WILLIAM H	*Johns Hopkins University, Baltimore, Md.*	1905
IDDINGS, JOSEPH P	*U. S. Geological Survey, Washington, D. C.*	1907
JACKSON, CHARLES L	*6 Boylston Hall, Cambridge, Mass.*	1883
JENNINGS, HERBERT SPENCER	*Johns Hopkins University, Baltimore, Md.*	1914
KEMP, JAMES F	*Columbia University, New York City.*	1911
LEUSCHNER, ARMIN O	*University of California, Berkeley, Cal.*	1913
LEVENE, PHŒBUS AARON THEODOR	*Rockefeller Institute, New York City.*	1916
LEWIS, GILBERT N	*University of California, Berkeley, Cal.*	1913
LILLIE, FRANK RATTRAY	*University of Chicago, Chicago, Ill.*	1915
LINDGREN, WALDEMAR	*Mass. Inst. of Technology, Boston, Mass.*	1909
LOEB, JACQUES	*Rockefeller Institute, New York City.*	1910
LUSK, GRAHAM	*Cornell University Medical College, New York City.*	1915
MALL, FRANKLIN P	*Johns Hopkins University, Baltimore, Md.*	1907
MARK, EDWARD L	*109 Irving St., Cambridge, Mass.*	1903
MAYER, ALFRED GOLDSBOROUGH	*Carnegie Institution, Maplewood, N. J.*	1916
MELTZER, SAMUEL JAMES	*Rockefeller Institute, New York City.*	1912
MENDEL, LAFAYETTE B	*18 Trumbull St., New Haven, Conn.*	1913
MENDENHALL, THOMAS C	*329 North Chestnut St., Ravenna, Ohio.*	1887
MERRIAM, C. HART	*1919 16th St., Washington, D. C.*	1902
MERRITT, ERNEST	*Cornell University, Ithaca, N. Y.*	1914
MICHAEL, ARTHUR	*219 Parker St., Newton Center, Mass.*	1889
MICHELSON, ALBERT A	*University of Chicago, Chicago, Ill.*	1888
MILLIKAN, ROBERT ANDREWS	*University of Chicago, Chicago, Ill.*	1915
MOORE, ELIAKIM H	*University of Chicago, Chicago, Ill.*	1901
MORGAN, T. H	*Columbia University, New York City.*	1909
MORLEY, EDWARD W	*West Hartford, Conn.*	1897
MORSE, EDWARD S	*Salem, Mass.*	1876

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		Date of election.
MORSE, HARMON N.	*Johns Hopkins University, Baltimore, Md.*	1907
MOULTON, F. R.	*University of Chicago, Chicago, Ill.*	1910
NICHOLS, EDWARD L.	*Cornell University, Ithaca, N. Y.*	1901
NICHOLS, ERNEST F.	*Yale University, New Haven, Conn.*	1908
NOYES, ARTHUR A.	*Massachusetts Institute of Technology, Boston, Mass.*	1905
NOYES, WILLIAM A.	*University of Illinois, Urbana, Ill.*	1910
OSBORN, H. F.	*American Museum of Natural History, New York City.*	1900
OSBORNE, T. B.	*Agricultural Experiment Station, New Haven, Conn.*	1910
OSGOOD, WILLIAM FOGG.	*Harvard University, Cambridge, Mass.*	1904
PARKER, GEORGE H.	*16 Berkeley St., Cambridge, Mass.*	1913
PEARL, RAYMOND.	*Maine Agricultural Experiment Station, Orono, Me.*	1916
PICKERING, EDWARD C.	*Harvard College Observatory, Cambridge, Mass.*	1873
PIRSSON, LOUIS V.	*41 Trumbull St., New Haven, Conn.*	1913
PRUDDEN T. MITCHELL.	*Columbia University, New York City.*	1901
PUMPELLY, RAPHAEL.	*Gibbs Ave., Newport, R. I.*	1872
PUPIN, MICHAEL I.	*Columbia University, New York City.*	1905
RANSOME, FREDERICK LESLIE.	*U. S. Geological Survey, Washington, D. C.*	1914
REID, H. FIELDING.	*Johns Hopkins University, Baltimore, Md.*	1912
REMSEN, IRA.	*Johns Hopkins University, Baltimore, Md.*	1882
RICHARDS, THEODORE W.	*Wolcott Gibbs Mem. Lab., Cambridge, Mass.*	1899
ROSA, EDWARD B.	*Bureau of Standards, Washington, D. C.*	1913
SARGENT, CHARLES S.	*Arnold Arboretum, Jamaica Plain, Mass.*	1895
SCHLESINGER, FRANK.	*Allegheny Observatory, Allegheny, Pa.*	1916
SCHUCHERT, CHARLES.	*Yale University, New Haven, Conn.*	1910
SCOTT, WILLIAM B.	*Princeton University, Princeton, N. J.*	1906
SMITH, ALEXANDER.	*Columbia University, New York City.*	1915
SMITH, EDGAR F.	*University of Pennsylvania, Philadelphia, Pa.*	1899
SMITH, ERWIN F.	*Bureau of Plant Industry, Washington, D. C.*	1913
SMITH, THEOBALD.	*Princeton, N. J.*	1908
STIEGLITZ, JULIUS.	*University of Chicago, Chicago, Ill.*	1911
STORY, WILLIAM E.	*Clark University, Worcester, Mass.*	1908
THAXTER, ROLAND.	*Harvard University, Cambridge, Mass.*	1912
THOMSON, ELIHU.	*Swampscott, Mass.*	1907
TRELEASE, WILLIAM.	*University of Illinois, Urbana, Ill.*	1902
TROWBRIDGE, JOHN.	*Harvard University, Cambridge, Mass.*	1878
VAN HISE, C. R.	*University of Wisconsin, Madison, Wis.*	1902
VAN VLECK, E. B.	*University of Wisconsin, Madison, Wis.*	1911
VAUGHAN, VICTOR CLARENCE.	*University of Michigan, Ann Arbor, Mich.*	1915
VERRILL, A. E.	*47 Cedar Grove Ave., New London, Conn.*	1872
WALCOTT, CHARLES D.	*Smithsonian Institution, Washington, D. C.*	1896
WEBSTER, ARTHUR G.	*Clark University, Worcester, Mass.*	1903
WELCH, WILLIAM H.	*807 St. Paul St., Baltimore, Md.*	1895
WELLS, HORACE L.	*Yale University, New Haven, Conn.*	1903
WHEELER, WILLIAM M.	*Harvard University, Cambridge, Mass.*	1912
WHITE, DAVID.	*U. S. Geological Survey, Washington, D. C.*	1912
WHITE, HENRY SEELY.	*Vassar College, Poughkeepsie, N. Y.*	1915
WILLISTON, SAMUEL WENDELL.	*University of Chicago, Chicago, Ill.*	1915
WILSON, EDMUND B.	*Columbia University, New York City.*	1899
WOOD, HORATIO C.	*4107 Chester Ave., Philadelphia, Pa.*	1879
WOOD, ROBERT W.	*Johns Hopkins University, Baltimore, Md.*	1912
WOODWARD, ROBERT S.	*Carnegie Institution, Washington, D. C.*	1896

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HONORARY MEMBER.

		Date of election.
SMITH, SIDNEY I.	*Yale University, New Haven, Conn.*	1884

FOREIGN ASSOCIATES.

ARRHENIUS, S. A.	*Nobelinstitut, Stockholm.*	1908
BAEYER, ADOLPH RITTER VON	*Universität, Munich.*	1898
BARROIS, CHARLES	*Université, Lille.*	1908
BRØGGER, W. C.	*Universitet, Christiania.*	1903
CROOKES, SIR WILLIAM	*London.*	1913
DARBOUX, GASTON	*Academy of Sciences, Paris.*	1913
DESLANDRES, HENRI	*Astrophysical Observatory, Meudon.*	1913
DEWAR, SIR JAMES	*University, Cambridge.*	1907
FISCHER, EMIL	*Chemisches Institut der Universität, Berlin.*	1904
FORSYTH, A. R.	*Imperial College of Science and Technology, London.*	1907
GEIKIE, SIR ARCHIBALD	*Haslemere, Surrey.*	1901
GROTH, PAUL VON	*Universität, Munich.*	1905
HEIM, ALBERT	*Zürich.*	1913
HILBERT, DAVID	*Universität, Göttingen.*	1907
KAPTEYN, JOHN C.	*Rijks Universiteit, Groningen.*	1907
KLEIN, FELIX	*Universität, Göttingen.*	1898
KÖSSEL, ALBRECHT	*Heidelberg.*	1913
KUSTNER, KARL FRIEDRICH	*Bonn.*	1913
LANKESTER, SIR E. RAY	*South Kensington, London.*	1903
LARMOR, SIR JOSEPH	*St. John's College, Cambridge.*	1908
LORENTZ, HENDRIK ANTON	*Rijks Universiteit, Leiden.*	1906
OSTWALD, WILHELM	*Grossbothen, bei Leipzig.*	1906
PAVLOV, IVAN PETROVITCH	*Imperial Institute for Experimental Medicine, Petrograd.*	1908
PENCK, ALBRECHT	*Universität, Berlin.*	1909
PFEFFER, WILHELM	*Botanische Institut der Universität, Leipzig.*	1903
PICARD, CHARLES ÉMILE	*Université, Paris.*	1903
RAYLEIGH, LORD	*University, Cambridge.*	1898
RETZIUS, GUSTAV	*Högskolan, Stockholm.*	1909
RUTHERFORD, SIR ERNEST	*University, Manchester.*	1911
SCHUSTER, ARTHUR	*Secretary of the Royal Society, London.*	1913
SEELIGER, HUGO RITTER VON	*Universität, Munich.*	1908
THOMSON, SIR JOSEPH	*University, Cambridge.*	1908
VOLTERRA, VITO	*Università, Rome.*	1911
VRIES, HUGO DE	*Universiteit, Amsterdam.*	1904
WAALS, JOHANNES D. VAN DER	*Amsterdam.*	1913
WALDEYER, WILHELM	*Universität, Berlin.*	1909
WOLF, MAX F. J. C.	*Heidelberg.*	1913
WUNDT, WILHELM	*Universität, Leipzig.*	1909

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DECEASED MEMBERS.

	Date of election.	Date of death.
ABBE, CLEVELAND	1879 [1]	Oct. 28, 1916
AGASSIZ, ALEXANDER	1866	Mar. 27, 1910
AGASSIZ, LOUIS	(1)	Dec. 14, 1873
ALEXANDER, J. H	(1)	Mar. 2, 1867
ALEXANDER, STEPHEN	(1)	June 25, 1883
BACHE, ALEXANDER DALLAS	(1)	Feb. 14, 1867
BAIRD, SPENCER F	1864	Aug. 19, 1887
BARKER, GEORGE F	1876 [2]	May 24, 1910
BARNARD, F. A. P	(1) (2)	Apr. 27, 1889
BARNARD, J. G	(1)	May 14, 1882
BARTLETT, W. H. C	(1)	Feb. 11, 1893
BEECHER, CHARLES EMERSON	1899	Feb. 14, 1904
BILLINGS, JOHN S	1883 [2]	Mar. 11, 1913
BOSS, LEWIS	1889 [2]	Oct. 5, 1912
BOWDITCH, HENRY P	1887 [2]	Mar. 13, 1911
BREWER, WILLIAM H	1880 [2]	Nov. 2, 1910
BROOKS, WILLIAM KEITH	1884	Nov. 12, 1908
BROWN-SEQUARD, CHARLES E	1868	Apr. 2, 1894
BRUSH, GEORGE JARVIS	1868 [2]	Feb. 6, 1912
CASEY, THOMAS L	1890	Mar. 25, 1896
CASWELL, ALEXIS	(1)	Jan. 8, 1877
CHANDLER, SETH CARLO	1888 [2]	Dec. 31, 1913
CHAUVENET, WILLIAM	(1)	Dec. 13, 1870
CLARK, HENRY JAMES	1872	July 1, 1873
COFFIN, JAMES H	1869	Feb. 6, 1873
COFFIN, J. H. C	(1)	Jan. 8, 1890
COMSTOCK, CYRUS B	1884	May 29, 1910
COOK, GEORGE H	1887	Sept. 22, 1889
COOKE, JOSIAH P	1872	Sept. 3, 1894
COPE, EDWARD D	1872 [2]	Apr. 12, 1897
COUES, ELLIOTT	1877	Dec. 25, 1899
DALTON, J. C	1864	Feb. 2, 1889
DANA, JAMES D	(1) (2)	Apr. 14, 1895
DAVIDSON, GEORGE	1874 [2]	Dec. 2, 1911
DAVIS, CHARLES H	(1)	Feb. 18, 1877
DRAPER, HENRY	1877	Nov. 20, 1882
DRAPER, JOHN W	1877	Jan. 4, 1882
DUTTON, C. E	1884 [2]	Jan. 4, 1912
EADS, JAMES B	1872	Mar. 8, 1887
EMMONS, SAMUEL F	1892	Mar. 28, 1911
ENGELMANN, GEORGE	(1)	Feb. 4, 1884
FERREL, WILLIAM	1868	Sept. 18, 1891
FRASER, JOHN FRIES	(1)	Oct. 12, 1872
GABB, WILLIAM M	1876	May 30, 1878
GENTH, F. A	1872	Feb. 2, 1893
GIBBS, JOSIAH WILLARD	1879	Apr. 28, 1903
GIBBS, WOLCOTT	(1)	Dec. 9, 1908
GILL, THEODORE NICHOLAS	1873	Sept. 25, 1914
GILLISS, JAMES MELVILLE	(1)	Feb. 9, 1865
GOODE, G. BROWN	1888	Sept. 6, 1896
GOULD, AUGUSTUS A	(1)	Sept. 15, 1866
GOULD, BENJAMIN A	(1) (2)	Nov. 26, 1896
GRAY, ASA	(1)	Jan. 30, 1888
GUYOT, ARNOLD	(1)	Feb. 8, 1884

[1] Charter members, Mar. 3, 1863. [2] Biographical notices have not been presented.

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Deceased members—Continued.

	Date of election.	Date of death.
HADLEY, JAMES	1872	Nov. 14, 1872
HALDEMAN, S. S	1876	Sept. 20, 1880
HALL, ASAPH	1875	Nov. 22, 1907
HALL, JAMES	(1) (2)	Aug. 7, 1898
HAYDEN, F. V	1873	Dec. 22, 1887
HENRY, JOSEPH	(1)	May 13, 1878
HILGARD, EUGENE W	1872 [2]	Jan. 8, 1916
HILGARD, JULIUS E	(1)	May 9, 1890
HILL, GEORGE WILLIAM	1874	Apr. 16, 1914
HILL, HENRY B	1883	Apr. 6, 1903
HITCHCOCK, EDWARD	(1)	Feb. 27, 1864
HOLBROOK, J. E	1868	Sept. 8, 1871
HOLDEN, EDWARD SINGLETON	1885	Mar. 16, 1914
HUBBARD, J. S	(1)	Aug. 16, 1863
HUMPHREYS, A. A	(1)	Dec. 27, 1883
HUNT, T. STERRY	1873 [2]	Feb. 12, 1892
HYATT, ALPHEUS	1875	Jan. 15, 1902
JAMES, WILLIAM [3]	1903	Aug. 26, 1910
JOHNSON, S. W	1866	July 21, 1909
KEELER, J. E	1900	Aug. 12, 1900
KING, CLARENCE	1876	Dec. 24, 1901
KIRTLAND, JARED P	1865	Dec. 10, 1877
LANE, J. HOMER	1872	May 3, 1880
LANGLEY, SAMUEL P	1876	Feb. 27, 1906
LEA, MATTHEW CAREY	1892	Mar. 15, 1897
LE CONTE, JOHN	1878	Apr. 29, 1891
LE CONTE, JOHN L	(1)	Nov. 15, 1883
LE CONTE, JOSEPH	1875	July 6, 1901
LEIDY, JOSEPH	(1)	Apr. 30, 1891
LESLEY, J. PETER	(1)	June 1, 1903
LESQUEREUX, LEO	1864	Oct. 20, 1889
LONGSTRETH, MIERS F	(1)	Dec. 27, 1891
LOOMIS, ELIAS	1873	Aug. 15, 1889
LOVERING, JOSEPH	1873	Jan. 18, 1892
LYMAN, THEODORE	1872	Sept. 9, 1897
MAHAN, D. H	(1)	Sept. 16, 1871
MARSH, G. P	1866	July 23, 1882
MARSH, O. C	1874 [2]	Mar. 18, 1899
MAYER, ALFRED M	1872	July 13, 1897
MAYO-SMITH, RICHMOND	1890 [2]	Nov. 11, 1901
MEEK, F. B	1869	Dec. 21, 1876
MEIGS, M. C	1865	Jan. 2, 1892
MINOT, CHARLES SEDGWICK	1897 [2]	Nov. 19, 1914
MITCHELL, HENRY	1885 [2]	Dec. 1, 1902
MITCHELL, SILAS WEIR	1865 [2]	Jan. 4, 1914
MORGAN, LEWIS H	1875	Dec. 17, 1881
MORTON, HENRY	1874	May 9, 1892
NEF, JOHN ULRIC	1904 [2]	Aug. 13, 1915
NEWBERRY, J. S	(1)	Dec. 7, 1892
NEWCOMB, SIMON	1869 [2]	July 11, 1909
NEWTON, H. A	(1)	Aug. 12, 1896
NEWTON, JOHN	1876	May 1, 1895
NORTON, WILLIAM A	1873	Sept. 21, 1883

[1] Charter members, Mar. 3, 1863.
[2] Biographical notices have not been presented.
[3] Resigned in 1908 or 1909.

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Deceased members—Continued.

	Date of election.	Date of death.
OLIVER, JAMES E	1872	Mar. 27, 1895
PACKARD, A. S	1872 [2]	Feb. 14, 1905
PEIRCE, BENJAMIN [3]	(1) (3)	Oct. 6, 1880
PENFIELD, SAMUEL L	1900	Aug. 13, 1906
PETERS, C. H. F	1876 [2]	July 18, 1890
PIERCE, BENJAMIN OSGOOD	1906 [2]	Jan. 14, 1914
PIERCE, CHARLES SANTIAGO SANDERS	1876 [2]	Apr. 20, 1914
POURTALES, L. F	1873	July 19, 1880
POWELL, JOHN W	1880	Sept. 23, 1902
PUTNAM, FREDERICK W	1885 [2]	Aug. 18, 1915
RODGERS, JOHN	(1)	May 5, 1882
ROGERS, FAIRMAN	(1)	Aug. 22, 1900
ROGERS, ROBERT E. [4]	(1)	Sept. 6, 1884
ROGERS, WILLIAM A	1885	Mar. 1, 1898
ROGERS, WILLIAM B. [5]	(1)	May 30, 1882
ROOD, OGDEN N	1865	Nov. 12, 1902
ROWLAND, HENRY A	1881	Apr. 16, 1901
ROYCE, JOSIAH	1906 [2]	Sept. 14, 1916
RUTHERFURD, LEWIS M	(1)	May 30, 1892
SAXTON, JOSEPH	(1)	Oct. 26, 1873
SCHOTT, CHARLES A	1872	July 31, 1901
SCUDDER, SAMUEL H	1877 [2]	May 17, 1911
SELLERS, WILLIAM	1873 [2]	Jan. 24, 1905
SILLIMAN, BENJ., Sr	(1)	Nov. 24, 1864
SILLIMAN, BENJ., Jr	(1)	Jan. 14, 1885
SMITH, J. LAWRENCE	1872	Oct. 12, 1883
STIMPSON, WILLIAM	1868 [2]	May 26, 1872
STRONG, THEODORE	(1)	Feb. 1, 1869
SULLIVANT, W. S	1872	Apr. 30, 1873
TORREY, JOHN	(1)	Mar. 10, 1873
TOTTEN, J. G	(1)	Apr. 22, 1864
TROWBRIDGE, WILLIAM P	1872	Aug. 12, 1892
TRUMBULL, JAMES H	1872	Aug. 5, 1897
TUCKERMAN, EDWARD	1868	Mar. 15, 1886
WALKER, FRANCIS A	1878	Jan. 5, 1897
WARREN, G. K	1876	Aug. 8, 1882
WATSON, JAMES C	1868	Nov. 23, 1880
WATSON, SERENO	1889	Mar. 9, 1892
WHEELER, HENRY LORD	1909 [2]	Oct. 30, 1914
WHITE, CHARLES A	1889	June 29, 1910
WHITMAN, C. O	1895	Dec. 6, 1910
WHITNEY, JOSIAH D. [6]	(1) (3)	Aug. 19, 1896
WHITNEY, WILLIAM D. [6]	1865 [2]	June 9, 1894
WINLOCK, JOSEPH	(1)	June 11, 1875
WOODWARD, J. J	1873	Aug. 17, 1884
WORTHEN, A. H	1872	May 6, 1888
WRIGHT, ARTHUR WILLIAMS	1881 [3]	Dec. 19, 1915
WYMAN, JEFFRIES	(1)	Sept. 4, 1874
YOUNG, CHARLES A	1872	Jan. 3, 1908

[1] Charter members, Mar. 3, 1863.
[2] Biographical notices have not been presented.
[3] Resigned 1873.
[4] Dropped —, reelected 1875.
[5] Dropped —, reelected 1872.
[6] Resigned.

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DECEASED FOREIGN ASSOCIATES.

ADAMS, J. C.
AIRY, SIR GEORGE B.
ÅNGELANDER, F. W. A.
AUWERS, G. F. J. ARTHUR
BACKLUND, OSKAR
BAER, KARL ERNEST VON
BARRANDE, JOACHIM
BEAUMONT, L. ÉLIE DE
BECQUEREL, HENRI
BERTHELOT, M. P. E.
BERTRAND, J. L. F.
BOLTZMANN, LUDWIG
BORNET, EDOUARD
BOUSSINGAULT, J. B. J. D.
BOVERI, THEODOR
BRAUN, ALEXANDER
BREWSTER, SIR DAVID
BUNSEN, ROBERT W.
BURMEISTER, C. H. C.
CANDOLLE, ALPHONSE DE
CAYLEY, ARTHUR
CHASLES, MICHEL
CHEVREUL, M. E.
CLAUSIUS, RUDOLPH
CORNU, ALFRED
DARWIN, SIR GEORGE HOWARD
DOVE, H. W.
DUMAS, J. B.
EHRLICH, PAUL
FARADAY, MICHAEL
GEGENBAUR, KARL
GLYDÉN, HUGO
GILL, SIR DAVID
HAMILTON, SIR WILLIAM ROWAN
HELMHOLTZ, BARON H. VON
HOFF, J. H. VAN'T
HOFMANN, A. W.
HOOKER, SIR JOSEPH D.
HUGGINS, SIR WILLIAM
HUXLEY, T. H.
IBAÑEZ, CARLOS
JANSSEN, J.
JOULE, JAMES P.
KEKULÉ, AUGUST
KELVIN, LORD
KIRCHOFF, G. R.
KOCH, ROBERT
KOHLRAUSCH, FRIEDRICH
KÖLLIKER, ALBERT VON
KRONECKER, HUGO
LACAZE-DUTHIERS, HENRI DE
LEUCKART, RUDOLPH
LIE, SOPHUS
LIEBIG, JUSTUS VON
LISTER, LORD
LOEWY, MAURICE
LUDWIG, K. F. W.
MAREY, E. J.
MENDELÉEFF, D. I.
MILNE-EDWARDS, HENRI
MOISSAN, HENRI
MURCHISON, SIR RODERICK I.
MURRAY, SIR JOHN
OPPOLZER, THEODORE VON
OWEN, SIR RICHARD
PASTEUR, LOUIS
PETERS, C. A. F.
PLANA, G. A. A.
POINCARÉ, JULES HENRI
RAMMELSBERG, C. F.
RAMSAY, SIR WILLIAM
REGNAULT, VICTOR
REYMOND, EMIL DU BOIS
RICHTHOFEN, F. VON
ROSENBUSCH, KARL HARRY FERDINAND
SACHS, JULIUS VON
SCHIAPARELLI, GIOVANNI
STAS, JEAN SERVAIS
STOKES, SIR GEORGE G.
STRASBURGER, EDOUARD
STRUVE, OTTO VON
SUESS, EDUARD
SYLVESTER, J. J.
TISSERAND, F. F.
VIRCHOW, RUDOLPH VON
VOGEL, H. C.
WEIERSTRASS, KARL
WEISMANN, AUGUST
WÖHLER, FRIEDRICH
WÜRTZ, ADOLPH
ZIRKEL, FERDINAND
ZITTEL, K. A. R. VON

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REPORT

OF THE

NATIONAL ACADEMY OF SCIENCES

FOR THE YEAR

1917

WASHINGTON
GOVERNMENT PRINTING OFFICE
1918

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REPORT

OF THE

NATIONAL ACADEMY OF SCIENCES

FOR THE YEAR

1917

WASHINGTON
GOVERNMENT PRINTING OFFICE
1918

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IN THE SENATE OF THE UNITED STATES,

March 8, 1918.

Resolved, That the report of the National Academy of Sciences for the year ending December 31, 1917, transmitted to the Senate on February 21, 1918, as provided for in the act approved March 3, 1863, be printed as a Senate document.

Attest:

JAMES M. BAKER,
Secretary.

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CONTENTS.

	Page.
Letter of transmittal	5
Act of incorporation	6
Amendments	7
Meetings of the National Academy, 1917	9
Annual meeting	9
Members in attendance	9
Business sessions	10
Announcement of deaths	10
Local committee	10
Finance committee of proceedings	10
Delegate	10
Report of the home secretary	10
Report of the foreign secretary	11
Report of the treasurer	11
Report of the directors of the Bache fund	11
Report of the trustees of the Watson fund	13
Report of the committee on the Henry Draper fund	14
Report of the committee on the J. Lawrence Smith fund	14
Report of the directors of the Wolcott Gibbs fund	14
Report of the committee on the Murray fund	15
Report of the committee on biographical memoirs	15
Daniel Giraud Eliot fund	16
Resignation of President Welch	16
Autumn meeting	17
Election of officers and members	17
Section and committee announcements	18
Trustees of the Watson fund	18
International academies	18
Platinum	19
Award of medal	19
Scientific sessions	20
April 16	20
April 17	20
April 18	21
Autumn meeting	21
Members in attendance	21
Business sessions	22
Announcement of deaths	22
Biographical memoirs	22
Editorial board	22
Section and committee announcements	22
Report of the editorial board	22
Institutions which have contributed three or more articles to proceedings each year	24
Summary of articles in first three volumes of proceedings	24
Auditing committee	24

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Meetings of the National Academy, 1917—Continued.
Autumn meeting—Continued.
Business sessions—Continued. Page.
Annual tables of constants ... 24
Engineering section ... 25
Classification of scientific men for war service ... 25
Report of the committee on the Comstock fund ... 29
Amendments to constitution and rules ... 29
The Watson fund ... 30
Proceedings deficit ... 30
Contributions to the support of the proceedings ... 30
Scientific sessions ... 31
November 20 ... 31
November 21 ... 32
Deceased members:
William Bullock Clark ... 33
Arnold Hague ... 36
Franklin Paine Mall ... 39
Adolf von Baeyer ... 41
Report of the National Research Council ... 46
Research information committee ... 48
Activities of committees ... 50
Financial support ... 53
War organization ... 54
Future of the National Research Council ... 64
Statement of contributions ... 65
Annual report of the treasurer ... 67
General review of financial transactions ... 67
Trust funds of the academy ... 68
Statement of assets and liabilities ... 69
Condensed statement of receipts and expenditures ... 72
Accounts with individual funds ... 74
Report of auditing committee ... 80
Appendixes ... 81
Appendix A—Constitution of the National Academy ... 83
Appendix B—Rules ... 90
Appendix C—Organization of the academy, 1916-17 ... 96
Sections ... 96
Standing committees ... 98
Trust funds ... 98
Members of the National Academy of Sciences, December 31, 1917. 101
Honorary member ... 104
Foreign associates ... 104
Deceased members ... 105
Deceased foreign associates ... 108

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LETTER OF TRANSMITTAL.

NATIONAL ACADEMY OF SCIENCES,
February 20, 1918.

The Honorable THOMAS R. MARSHALL,
Vice President of the United States,
Washington, D. C.

SIR: I have the honor to transmit to you herewith the annual report of the president of the National Academy of Sciences for the year ending December 31, 1917.

Very respectfully,

ARTHUR L. DAY,
Home Secretary.

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ACT OF INCORPORATION.

AN ACT To incorporate the National Academy of Sciences.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That Louis Agassiz, Massachusetts; J. H. Alexander, Maryland; S. Alexander, New Jersey; A. D. Bache, at large; F. B. Barnard,[1] at large; J. G. Barnard, United States Army, Massachusetts; W. H. C. Bartlett, United States Military Academy, Missouri; U. A. Boyden,[2] Massachusetts; Alexis Caswell, Rhode Island; William Chauvenet, Missouri; J. H. C. Coffin, United States Naval Academy, Maine; J. A. Dahlgren,[2] United States Navy, Pennsylvania; J. D. Dana, Connecticut; Charles H. Davis, United States Navy, Massachusetts; George Engelmann, Saint Louis, Missouri; J. F. Frazer, Pennsylvania; Wolcott Gibbs, New York; J. M. Gilless,[3] United States Navy, District of Columbia; A. A. Gould, Massachusetts; B. A. Gould, Massachusetts; Asa Gray, Massachusetts; A. Guyot, New Jersey; James Hall, New York; Joseph Henry, at large; J. E. Hilgard, at large, Illinois; Edward Hitchcock, Massachusetts; J. S. Hubbard, United States Naval Observatory, Connecticut; A. A. Humphreys, United States Army, Pennsylvania; J. L. Le Conte, United States Army, Pennsylvania; J. Leidy, Pennsylvania; J. P. Lesley, Pennsylvania; M. F. Longstreth, Pennsylvania; D. H. Mahan, United States Military Academy, Virginia; J. S. Newberry, Ohio; H. A. Newton, Connecticut; Benjamin Peirce, Massachusetts; John Rodgers, United States Navy, Indiana; Fairman Rogers, Pennsylvania; R. E. Rogers, Pennsylvania; W. B. Rogers, Massachusetts; L. M. Rutherford, New York; Joseph Saxton, at large; Benjamin Silliman, Connecticut; Benjamin Silliman, junior, Connecticut; Theodore Strong, New Jersey; John Torrey, New York; J. G. Totten, United States Army, Connecticut; Joseph Winlock, United States Nautical Almanac, Kentucky; Jeffries Wyman, Massachusetts; J. D. Whitney, California; their associates and successors duly chosen, are hereby incorporated, constituted, and declared to be a body corporate, by the name of the National Academy of Sciences.

SEC. 2. *And be it further enacted*, That the National Academy of Sciences shall consist of not more than fifty ordinary members, and

[1] The official list of members gives the name of F. A. P. Barnard.
[2] Declined.
[3] The official list of members gives the name of J. M. Gillis.

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the said corporation hereby constituted shall have power to make its own organization, including its constitution, by-laws, and rules and regulations; to fill all vacancies created by death, resignation, or otherwise; to provide for the election of foreign and domestic members, the division into classes, and all other matters needful or usual in such institution, and to report the same to Congress.

SEC. 3. *And be it further enacted*, That the National Academy of Sciences shall hold an annual meeting at such place in the United States as may be designated, and the academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art, the actual expense of such investigations, examinations, experiments, and reports to be paid from appropriations which may be made for the purpose, but the academy shall receive no compensation whatever for any services to the Government of the United States.

Approved, March 3, 1863.

AMENDMENTS.

AN ACT To amend the act to incorporate the National Academy of Sciences.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the act to incorporate the National Academy of Sciences, approved March third, eighteen hundred and sixty-three, be, and the same is hereby, so amended as to remove the limitation of the number of ordinary members of said academy as provided in said act.

Approved, July 14, 1870.

AN ACT To authorize the National Academy of Sciences to receive and hold trust funds for the promotion of science, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the National Academy of Sciences, incorporated by the act of Congress, approved March third, eighteen hundred and sixty-three, and its several supplements, be, and the same is hereby, authorized and empowered to receive bequests and donations and hold the same in trust, to be applied by the said academy in aid of scientific investigations and according to the will of the donors.

Approved, June 20, 1884.

AN ACT To amend the act authorizing the National Academy of Sciences to receive and hold trust funds for the promotion of science, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the act to authorize the National Academy of Sciences to receive and hold

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trust funds for the promotion of science, and for other purposes, approved June twentieth, eighteen hundred and eighty-four, be, and the same is hereby, amended to read as follows:

"That the National Academy of Sciences, incorporated by the act of Congress approved March third, eighteen hundred and sixty-three, be, and the same is hereby, authorized and empowered to receive, by devise, bequest, donation, or otherwise, either real or personal property, and to hold the same absolutely or in trust, and to invest, reinvest, and manage the same in accordance with the provisions of its constitution, and to apply said property and the income arising therefrom to the objects of its creation and according to the instructions of the donors: *Provided, however*, That the Congress may at any time limit the amount of real estate which may be acquired and the length of time the same may be held by said National Academy of Sciences."

SEC. 2. That the right to alter, amend, or repeal this act is hereby expressly reserved.

Approved, May 27, 1914.

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ANNUAL REPORT

OF THE

NATIONAL ACADEMY OF SCIENCES.

MEETINGS OF THE NATIONAL ACADEMY.

During the year 1917 the academy held two stated meetings, the annual meeting in April, at Washington, and the autumn meeting in November, at Philadelphia, Pa.

ANNUAL MEETING.

The sessions were held at the Smithsonian Institution in Washington, April 16, 17, and 18, 1917.

Seventy-six members were present, as follows:

Abbot, C. G.
Abel, John Jacob
Barnard, E. E.
Becker, George F.
Bogert, M. T.
Cannon, W. B.
Cattell, James McK.
Chittenden, R. H.
Clark, W. B.
Clarke, F. W.
Clarke, J. M.
Conklin, E. G.
Coulter, J. M.
Crew, Henry
Cross, Whitman
Dall, William H.
Dana, Edward S.
Davenport, Charles B.
Davis, W. M.
Day, Arthur L.
Dewey, John
Donaldson, H. H.
Fewkes, J. W.
Flexner, Simon
Frost, Edwin B.
Gomberg, Moses
Hague, Arnold
Hale, George E.
Hall, Edwin H.
Harper, R. A.
Hayford, John F.
Hillebrand, William F.
Holmes, William H.
Howard, L. O.
Howell, W. H.
Iddings, J. P.
Jennings, H. S.
Lillie, F. R.
Loeb, Jacques
Lusk, Graham
Mall, Franklin P.
Meltzer, S. J.
Merriam, C. Hart
Merritt, Ernest
Michelson, A. A.
Millikan, R. A.
Moore, E. H.
Morley, E. W.
Nichols, Edward L.
Nichols, Ernest F.
Noyes, Arthur A.
Noyes, William A.
Osborn, H. F.
Pearl, Raymond

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Pickering, E. C.
Pupin, Michael I.
Ransome, F. L.
Remsen, Ira.
Rosa, Edward B.
Schlesinger, Frank
Scott, William B.
Smith, Erwin F.
Stieglitz, Julius
Van Vleck, E. B.
Vaughan, Victor Clarence
Walcott, Charles D.
Webster, A. G.
Welch, William H.
Wheeler, William M.
White, David
White, Henry Seely
Wilson, Edmund B.
Wood, Robert W.

BUSINESS SESSIONS.

ANNOUNCEMENTS OF DEATHS.

The president announced the death since the autumn meeting of one foreign associate, Gaston Darboux.

The annual report of the president to Congress for 1916 was presented and distributed.

The president announced the appointment of the following committees:

LOCAL COMMITTEE.

Charles G. Abbot, chairman.

Charles D. Walcott.
William H. Dall.
William F. Hillebrand.
Whitman Cross.

FINANCE COMMITTEE FOR THE PROCEEDINGS.

C. B. Davenport, chairman.

M. T. Bogert.
W. B. Clark.
F. R. Lillie.
Raymond Pearl.

DELEGATE.

Mr. William Trelease was selected to represent the academy at the inauguration of Walter Albert Jessup as president of Iowa State University.

REPORT OF THE HOME SECRETARY.

The PRESIDENT OF THE NATIONAL ACADEMY OF SCIENCES.

SIR: I have the honor to present the following report on the publications and membership of the National Academy of Sciences for the year ending April 18, 1917. The memoirs of the National Academy of Sciences, volume 14, memoir 1, entitled, "Report on Researches on the Chemical and Mineralogical Composition of Meteorites, with Especial Reference to their Minor Constituents," by George Perkins Merrill, was published and distributed. The biographical memoirs of Edward Singleton Holden, by W. W. Campbell; Theodore Nicholas Gill, by William Healey Dall; George William Hill, by Ernest W. Brown; and Alfred Marshall Mayer, by Alfred G. Mayer and Robert S. Woodward; also the annual report, 1916, have been published and distributed.

Two members have died since the last annual meeting. Cleveland Abbe, elected in 1878, died October 28, 1916; Josiah Royce, elected in 1906, died

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September 14, 1916. Foreign associates: Sir William Ramsey, elected 1904, died July 24, 1916, and Gaston Darboux, elected in 1913, died March, 1917. There are 147 active members on the membership list, 1 honorary member, and 37 foreign associates.

ARTHUR L. DAY, *Home Secretary.*

REPORT OF THE FOREIGN SECRETARY.

On April 6, 1917, a cablegram was prepared by Mr. Hale, foreign secretary of the academy, with the approval of the following members of the council: Welch, Walcott, Day, Cross, and Hale.

"The entrance of the United States into the war unites our men of science with yours in a common cause. The National Academy of Sciences, acting through the National Research Council, which has been designated by President Wilson and the Council of National Defense to mobilize the research facilities of the country, would gladly cooperate in any scientific researches still underlying the solution of military or industrial problems.

"HALE, *Foreign Secretary.*"

The cablegram was sent to Royal Society, London, England; Académie des Sciences, Paris, France; Accademia dei Lincei, Rome, Italy; Académie des Sciences, Petrograd, Russia.

GEORGE E. HALE, *Foreign Secretary.*

REPORT OF THE TREASURER.

The report of the treasurer was presented in its printed form and approved.

REPORT OF THE DIRECTORS OF THE BACHE FUND.

Since the annual meeting of the academy in April, 1916, the following grants have been made:

No. 196. Harry W. Norris, Grinnell College, Iowa, $100. For an investigation of the cranial nerve of the amphibia.

No. 197. Gregory P. Baxter, Harvard University, $300. For the determination of atomic weights of arsenic and iodine by iodimetric comparison of arsenic trioxide and iodine pentoxide, and of various metals by electrolysis of weighed amounts of salts, and by coulometric comparison.

No. 198. Louis T. More, University of Cincinnati, $500. For apparatus to be used in examining the region of the radiation spectrum between the hardest known X rays and the lambda rays of radium, and to examine the characteristic K radiation and its absorption by various metals.

No. 199. Frnklin P. Reagan, Woods Hole, $100. For an intensive study of hæmatopoisis is teleost embryos involving continual observation.

No. 200. H. W. Norris, Grinnell College, Iowa, $250. For an investigation of the cranial nerve components of the common dogfish, squales, acanthias; and analysis of the cranial ganglia and the peripheral distribution of the component fibers.

No. 201. A. Franklin Shull, University of Michigan, $400. To discover the causes of the changes in the life cycles of rotifers, aphids, and thrips, with special reference to the determination of sex; also related cyclical phenomena in the aphids, primarily the sporadic production of wings.

No. 202. W. C. Allee, Lake Forest College, Ill., $415. For an investigation of a possible correlation between the rate of carbon dioxide production and reversal in light reactions of certain Arthropods, especially May-fly nymphs.

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No. 203. Joseph P. Iddings, Brinklow, Md., $500. For a continuance of the microscopical and chemical investigation of rocks collected by Mr. Iddings in Japan, Philippine Islands, Java, Borneo, Celebes, Sumatra, New Zealand, Tahiti, the Leeward Islands, and the Marquesas.

No. 204. Irving W. Bailey, Bussey Institution, Harvard University, $300 To secure field data in regard to the effects of various tropical environments upon the growth forms of the angiosperms and to secure material for a study of the effects of these environments upon the anatomical structure of the angiosperms. (Expedition to Guatemala has been delayed.)

Reports of previous grants have been received as follows:

No. 186. J. Voûte, Royal Observatory, Cape of Good Hope. From a letter dated January 15, 1915, it appears that about 13,000 transits had then been observed for the purpose of determining stellar parallaxes. From a letter dated July 22, 1916: "The parallax work on the transit circle is nearly finished, but I have started a small series of about 125 stars on the astrographic refractor."

No. 187. H. H. Lane, University of Oklahoma. Preliminary report on "The structure and function in the development of the special senses in mammals." Science, 43, 179 (1916).

Nos. 188 and 196. H. W. Norris, Grinnell College. Research nearly ready for publication. Preliminary results on the cranial nerve of coecilians published in Science. 43, 182 (1916).

No. 189. E. J. Werber, Yale University. Experiments aiming at the origin of monsters. The greater part of the results are published in the Journal of Experimental Zoology, 21, Nos. 3 and 4 (1916). Record of award closed.

No. 190. H. S. Jennings, Johns Hopkins University. For research in variation, heredity, and evolution. Preliminary results published in Genetics, 1, 407–534 (1916?).

Nos. 184 and 191. P. W. Bridgman, Harvard University. To assist in the study of the effect of high pressures on the electrical resistance of metals. The results have been published in Proceedings of the National Academy of Sciences, 3, 10–12, 1917; Proceedings of the American Academy, 52, 571–646 (1917); and in a theoretical article soon to appear in the Physical Review. Record of award closed.

No. 192. J. P. Iddings, Brinklow, Md. For a microscopic study of volcanic rocks from the Dutch Indies, French Oceania, and the Philippines. Preliminary results are published in Proceedings of the National Academy of Sciences, 2, 531 (1916). Research being continued under grant 203.

No. 194. Reginald A. Daly, Harvard University. For the construction of a deep-sea thermograph. The vital part of the instrument is practically ready for testing, and it is hoped that the whole will be ready for work by May 1. The clockwork has been tested and shows capacity for taking 250 readings with one cast of the machine overboard. The manuscript descriptive of the instrument, by Dr. Harry Clark, the expert designer, to be illustrated with several full-page plates, is nearly completed. The necessary expenditure has considerably exceeded the appropriation.

No. 195. R. W. Hegner, University of Michigan. To assist a research of "Differential mitoses in the germ cell cycle of dineutes nigrior." Preliminary publication in Proceeding of the National Academy of Sciences, 2, 356–360, 1916.

No. 197. Gregory P. Baxter, Harvard University. The preparation of pure anhydrous zinc chloride and its analysis by electrolysis are under way and will probably be completed before the end of the college year.

No. 198. Louis T. More, University of Cincinnati. Preliminary results are published in the Physical Review, 9, 198–204, 1917, by J. S. Allen and L. M.

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Alexander, "On the effect of previous filtering upon the absorption of high frequency X rays." The research continues.

No. 199. Franklin P. Reagan, Princeton University. The partial results are published in the Anatomical Record, February, 1917, under the title "Anterior hæmatopœdis in teleost embryos under continual observation," by F. P. Reagan, E. E. MacMorland, and Stuart Mudd.

During the year the directors unanimously voted to cancel the rule heretofore effective for grants from the Bache fund, which stated "no appropriation will be made to assist any investigation begun or conducted under any National or State government, either wholly or in part."

The cash income balance of the fund on April 2, 1917, was $846.30; but there are outstanding grants, not yet paid, amounting to $2,050. Of three of these grants, amounting to $1,600, the recipients of which live in foreign countries, it seems to be impossible to make payments until the end of the war.

EDWIN B. FROST, *Chairman.*

REPORT OF THE TRUSTEES OF THE WATSON FUND.

The trustees of the Watson fund advise the academy that during the year the grant of $500 voted at the annual meeting for 1916 has been paid to Prof. John A. Miller, director of the Sproul Observatory of Swarthmore College, Pa., whose report may be condensed as follows:

"The money has been paid to an assistant, Miss Marie S. Bender, who has given all her energy to the measurement and reduction of plates for determining parallaxes. She has measured 130 plates of 24 different series and has computed the orientation factor and oriented 122 plates and has discussed eight different series by means of graphs. The continuance of the grant is requested."

A grant of $300 was made in April, 1916, to Prof. Herbert C. Wilson, of Carleton College, Northfield, Minn., who says in a letter dated April 7, 1917:

"We have measured all of our asteroid plates up to the beginning of this year, and all have been reduced. We are now going over the reductions thoroughly, checking them. * * * It will be a couple of months yet before we can get the matter ready for the press."

The grant of $300, made in 1915 to John E. Mellish, was used in 1915–16, and its record may be considered closed.

The following vote is recommended:

GRANT NO. 13.

Resolved, That the appropriation of $500 to Prof. John A. Miller be renewed for the year beginning July 1, 1917.

GRANT NO. 14.

Resolved, That $325 be appropriated for a continuance of the work conducted by Prof. Herbert C. Wilson, consisting of the determination of the position and brightness of asteroids (chiefly those discovered by Watson) by the photographic method, together with a study of the brightness of some variable stars.

The available income of the Watson fund on April 1, 1917, was $1,213.65.

EDWIN B. FROST, *Chairman.*
W. L. ELKINS.
G. C. COMSTOCK.

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REPORT OF THE COMMITTEE ON THE HENRY DRAPER FUND.

The committee recommends that a grant of $300 be made to Prof. Joel Stebbins, director of the observatory of the University of Illinois, in support of his investigations with sensitive photometers, particularly the photo-electric cell photometer; the grant to be available on or before September 1, 1917. It is understood that this grant will be supplemented by the appropriation of a sum two or three times as great to be made by the University of Illinois, and that the total sum will constitute the salary of a research assistant for Prof. Stebbins during the academic year 1917–18. It is expected that all of the assistant's time in the first year will be available for the researches in photometry, and that after the first year the university authorities will assume the full responsibility for the assistant's salary. Prof. Stebbins reports that improvements have been made in his photo-electric photometer. "A new quartz cell as compared with the cell used at Mount Hamilton (1915) gives twice the light effect, with the dark current five times smaller. It is therefore conservative to say that the sensibility has been doubled since 1915."

W. W. CAMPBELL, *Chairman.*

APRIL 2, 1917.

REPORT OF THE COMMITTEE ON THE J. LAWRENCE SMITH FUND.

Grant No. 3. E. O. Hovey, curator in geology and paleontology, American Museum of Natural History, New York, received in 1910 a grant of $400 to aid in the study of certain meteorites. Dr. Hovey has been for some years out of the country and has not been reached by letters. He has suggested the repayment of the amount of this grant.

Grant No. 4. Prof. C. C. Trowbridge, of the department of physics, Columbia University, New York, received a grant of $400 in 1910 to aid in study of luminous trains of meteors, and the academy has made four further grants of $250 each. During the last year good progress has been made in collecting photographs of drawings of meteor trains. One interesting result obtained is that the height of the zone of luminous trains agrees with the heights obtained in recent investigations on the auroral zone and is suggestive.

Grant No. 6. Prof. S. A. Mitchell, of the University of Virginia, received a grant of $500 in 1915 and a further grant of $300 in 1916 to aid in securing observations of paths and radiants of meteors and in computing orbits where observations are sufficient. Good progress has been made in the work; and the committee are unanimous in recommending a further grant of $400.

Grant No. 7. Dr. George P. Merrill, of the United States National Museum, received last November a grant of $400 to aid in further studies of the occurrence of certain elements in meteorites, for which he had formerly received grant No. 5, on which he had made his final report. This work is in progress.

The uninvested income now available for grants is $677.13.

EDWARD W. MORLEY, *Chairman.*

REPORT OF THE DIRECTORS OF THE WOLCOTT GIBBS FUND.

The directors of the Wolcott Gibbs fund for chemical research have the honor of presenting the following report to the National Academy of Sciences:

The accumulated income of the fund amounted to $356.11 on March 1, 1917. Since that date a grant of $200, No. 7, has been made to Prof. W. D. Harkins, of the University of Chicago, for the purchase of an air pump, which will be of use in five researches either now in progress or to be undertaken in the near future.

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Also a grant, No. 8, of £25 to Prof. H. L. Datta, of Presidency College, Calcutta, India, to provide organic substances for his researches of chlorination.

Satisfactory reports have been received from holders of previous grants.

Grants 1 and 5. Prof. Mary E. Holmes reports that her paper on the electrical deposition of copper is nearly ready for publication and that she has studied the electrical separation of cadmium from eight other metals.

Grant 3. Prof. W. J. Hale has published the results of his work under this grant in a paper on "The formation of cyclopentadienodihydropyridazines," Journal American Chemical Society, 1916, pages 2537 to 2545, thus bringing the record of this grant to a successful end.

Grant 4. Prof. W. D. Harkins sends copies of three papers describing work done under this grant. (*a*) "The free energy of dilution and the freezing-point lowerings in solutions of some salts of various types of ionization and of salt mixtures." Harkins and R. E. Hall, Journal American Chemical Society, 38, pages 2658 to 2676. (*b*) "The freezing-point lowerings in aqueous solutions of salts and mixtures of salts and of a salt with a nonelectrolyte." Harkins and W. A. Roberts, Journal American Chemical Society, 38, pages 2676 to 2679. (*c*) "Studies on the Cobalt-ammines. I. Various ionization types as determined by the freezing-point lowerings in aqueous solution, together with conductance measurements." Harkins, Hall, and Roberts, Journal American Chemical Society, 38, pages 2643 to 2658.

Grant 6. Prof. G. P. Baxter reports that he has studied with the help of the grant: (*a*) Sources of error in the electrolytic determination of the atomic weight of cadmium, and analysis of cadmic sulphate; (*b*) gaseous impurities of silver and iodine; (*c*) relation between arsenious trioxide and iodine.

Each of these researches should be finished in a few months.

C. L. JACKSON, *Chairman.*
EDGAR F. SMITH.
THEODORE W. RICHARDS.

REPORT OF THE COMMITTEE ON THE MURRAY FUND.

The committee on the Murray fund has no recommendation to report this year. The conditions in Europe and the North Atlantic have precluded oceanographic work entirely, and consequently nothing in the way of progress can be reported. The statement of the treasurer of the academy showing the condition of the fund is appended.

WILLIAM H. DALL, *Chairman.*

The treasurer reports a cash income balance on the Murray fund of $274.97.

REPORT OF THE COMMITTEE ON BIOGRAPHICAL MEMOIRS.

The committee on biographical memoirs respectfully reports that a circular letter has been sent to each biographer asking for information concerning the progress of the memoir he has in charge. Responses to this inquiry revealed a few cases in which the assigned biographer was ignorant of his assignment, and others in which conditions made necessary a reassignment. The biography of William Stimpson has been prepared for the press by A. G. Mayer; that of F. A. P. Barnard is promised by C. F. Chandler in about three weeks.

Biographies of all members who died more than 15 years ago are thus accounted for.

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A circular letter was sent to all members in December suggesting that each prepare at the end of each year an autobiographical record for the preceding year. A number of members have utilized this suggestion and a number have deposited biographical material with the committee.

C. B. DAVENPORT, *Chairman.*
G. C. COMSTOCK.
A. G. MAYER.
A. L. DAY.

DANIEL GIRAUD ELLIOT FUND.

The council reported the acceptance for the academy of the gift of $8,000, made to the National Academy of Sciences by Miss Margaret Henderson Elliot in pursuance of her desire to carry out a testamentary provision in the will of her father, Daniel Giraud Elliot, which would have been operative under circumstances stated in the will and applied in accordance with the terms of the legacy as fully set forth in the will whereby a medal, to be known as the Daniel Giraud Elliot gold medal, together with an accompanying diploma and an unexpended balance of income for the year, was to be awarded annually to the author of such paper, essay, or other work upon some branch of zoology or paleontology published during the year as in the opinion of the judges, who shall be Henry Fairfield Osborn, of New York, the scientific director of the American Museum of Natural History, and the secretary of the Smithsonian Institution, shall be the most meritorious and worthy of honor.

RESIGNATION OF PRESIDENT WELCH.

Mr. William H. Welch presented the following letter, resigning the presidency of the academy, to take effect with the close of the present meeting, which was accepted with great regret:

NATIONAL ACADEMY OF SCIENCES,
April 16, 1917.

To the MEMBERS OF THE NATIONAL ACADEMY OF SCIENCES:

GENTLEMEN: In accordance with the intention which I announced at our semi-annual meeting last November, I hereby tender my resignation of the office of president of the academy, to take effect at the close of the present annual meeting.

It is mainly the assumption of new and exacting duties and responsibilities connected with the organization and development of the School of Hygiene and Public Health recently established at the Johns Hopkins University which leads me to withdraw from a position which should receive much of the time and thought and energy of the incumbent.

It is a source of gratification that the academy, while retaining its distinguished position as representative of those most eminent for their contributions to science in America, has widened in recent years its field of activities and thereby become more useful and significant in the advancement of science in our country. It is to be hoped and expected that the academy in its activities, influence, and membership will be still further broadened and become

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increasingly serviceable and important in the promotion of knowledge and of the welfare of the Nation.

I wish to renew the expression of my profound appreciation of the very high honor which was conferred upon me four years ago by election to the presidency of the academy, as well as my appreciation of the continued loyalty and support and kindness of the members. I desire likewise to record my gratitude and indebtedness for the unfailing aid of the officers of the academy, and especially of the home secretary and the foreign secretary, who have really carried the burden of the conduct of affairs.

Faithfully, yours,

WILLIAM H. WELCH.

AUTUMN MEETING.

The invitation of the provost and trustees of the University of Pennsylvania to hold the autumn meeting in Philadelphia was accepted.

ELECTION OF OFFICERS AND MEMBERS.

President: Mr. Charles Doolittle Walcott was unanimously elected president for a term of six years to expire in 1923.

Vice president: Mr. A. A. Michelson was unanimously elected vice president for a term of six years to expire in 1923.

Treasurer: Mr. Whitman Cross was unanimously elected to succeed himself for a term of six years to expire in 1923.

Two members of the council: Mr. A. A. Noyes and Mr. E. G. Conklin were elected to succeed themselves for terms of three years each to expire in 1920.

The following members were elected:

Walter Sydney Adams, astronomer, Mount Wilson Solar Observatory of the Carnegie Institution of Washington, Pasadena, Cal.

Liberty Hyde Bailey, horticulturist, Ithaca, N. Y.

John J. Carty, electrical engineer, American Telegraph & Telephone Co., New York, N. Y.

Harvey Cushing, surgeon, Harvard University, Cambridge, Mass.

William Frederick Durand, mechanical engineer, Leland Stanford Junior University, Stanford University, Cal.

William Stewart Halsted, surgeon, Johns Hopkins Medical School, Baltimore, Md.

Henry Marion Howe, metallurgist, professor emeritus, Columbia University, New York, N. Y.

Edward Kasner, mathematician, Columbia University, New York, N. Y.

Theodore Lyman, physicist, Harvard University, Cambridge, Mass.

Robert Ridgway, ornithologist, United States National Museum, Washington, D. C.

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Wallace C. Sabine, physicist, Harvard University, Cambridge, Mass.

Samuel Wesley Stratton, physicist, Bureau of Standards, Washington, D. C.

Edward Lee Thorndike, psychologist, Columbia University, New York, N. Y.

Edward Oscar Ulrich, paleontologist, United States Geological Survey, Washington, D. C.

Willis Rodney Whitney, chemist, General Electric Co., Schenectady, N. Y.

SECTION AND COMMITTEE ANNOUNCEMENTS.

Section of astronomy: W. W. Campbell, chairman, 1920.

Program: C. G. Abbot, chairman, 1918; Raymond Pearl, 1920.

Henry Draper fund: A. A. Michelson, to succeed himself, 1922.

J. Lawrence Smith fund: Whitman Cross, 1922.

Comstock fund: A. G. Webster, to succeed himself, 1922.

Marsh fund: E. S. Dana, to succeed himself, 1920.

Murray fund: G. H. Parker, to succeed himself, 1920.

Marcellus Hartley fund: Theobald Smith, to succeed himself, 1920; A. G. Webster, to succeed himself, 1920.

On publication: E. B. Rosa.

TRUSTEES OF THE WATSON FUND.

The home secretary presented the following communication from Mr. Edwin B. Frost, resigning as a member of the trustees of the Watson fund:

APRIL 12, 1917.

DEAR MR. DAY: Please present to the council my resignation as a member of the trustees of the Watson fund. It is necessary for me to give up further service on this committee, but I am willing to continue as chairman of the Bache committee for another year.

Very truly, yours, EDWIN B. FROST.

The resignation of Mr. Frost was accepted and Mr. A. O. Leuschner was elected chairman of the trustees of the Watson fund.

INTERNATIONAL ACADEMIES.

The foreign secretary presented the following communication from the Académie des Sciences at Paris, received through the ambassador from France to the United States:

AMBASSADE,
DE LA REPUBLIQUE FRANCAISE,
AUX ETATS-UNIS,
Washington le April 16, 1917.

MY DEAR MR. SECRETARY: I am informed by my Government that our "Académie des Sciences" has received from the "National Academy of Sciences" a friendly telegram by which they have been deeply touched.

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I am instructed to forward to you their answer, the text of which is here inclosed. I have the honor to be, dear Mr. Secretary,

Sincerely, yours,

JUSSERAND.

Mr. HALE,

Foreign Secretary National Academy of Sciences,

Washington, D. C.

PARIS, *15 avril, 1917.*

NATIONAL ACADEMY OF SCIENCES,

Washington, D. C.:

L'Académie des Sciences de l'Institut de France est heureuse de saluer l'aide que votre noble pays apporte au nôtre, et à ses alliés dans leur lutte pour le droit et la liberté.

Elle vous remercie de votre offre, et sera heureuse de collaborer avec l'Académie Nationale des Sciences pour la solution des problèmes scientifiques intéressant la defénse nationale et l'industrie.

A. LACROIX,
EMILE PICARD,
Secrétaires Perpétuels.

The foreign secretary presented the following communication from the Royal Society, London, received through the ambassador from Great Britain to the United States:

Dr. GEORGE E. HALE,

Washington, D. C.:

The Royal Society heartily welcomes the offer of the National Academy to cooperate in scientific researches connected with the war, and will communicate by letter proposals for carrying this into effect.

THOMSON, *President.*

PLATINUM.

The following resolutions were adopted:

Whereas there is a great shortage in the supplies of platinum available for scientific and industrial purposes; and

Whereas the shortage is in very great measure due to the extensive use of platinum for jewelry and other articles of luxury: Therefore, be it

Resolved, That the National Academy of Sciences, in this critical situation where all the resources of the Nation should be put to the use of those immediately active in the constructive, productive, and defensive work of the country, appeal to the women and the men of America to refuse to purchase or accept as gifts jewelry and other articles made in whole or in part of platinum and thus to allow all the available supplies of the metal to be used where they can do the greatest good.

AWARD OF MEDALS.

The following medals were awarded at the annual dinner on the evening of April 17, 1917, at the Raleigh Hotel:

The Henry Draper Medal, to A. A. Michelson, of the University of Chicago, for his numerous and important contributions to spectroscopy and astronomical physics.

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The Medal for Eminence in the Application of Science to the Public Welfare, to Samuel Wesley Stratton, for his services in introducing standards into the practice of technologists in the United States.

SCIENTIFIC SESSIONS.

MEETING OF APRIL 16–18, 1917.

MONDAY, APRIL 16.

MORNING SESSION.

J. P. Iddings and E. W. Morley: Report of progress in the study of igneous rocks from the East Indies and Islands of the South Pacific.

W. M. Davis: The Great Barrier Reef of Queensland, Australia (illustrated).

Charles D. Walcott: Searching for a doubtful geological zone in the Canadian Rockies (illustrated).

Arthur L. Day: The role of the gases in volcanic activity (illustrated).

W. A. Noyes: A kinetic hypothesis to explain the function of electrons in the chemical combination of atoms.

A. A. Michelson (Draper Medalist, 1917): Some recent work in physics.

W. B. Cannon: Some considerations regarding the nature of thirst.

AFTERNOON SESSION.

Erwin F. Smith: On resemblances of crown gall to cancer: A synopsis of work done in the United States Department of Agriculture.

R. J. Anderson and Graham Lusk: The influence of diet upon the heat production during mechanical work in the dog.

Jacques Loeb and J. H. Northrop: What determines the natural duration of life?

A. G. Mayer: Biographical memoir of William Stimpson. (By title.)

Benjamin Boss: Biographical memoir of Lewis Boss. (By title.)

First William Ellery Hale lecture, by Edwin Grant Conklin, professor of zoology, Princeton University. Subject: Methods and causes of organic evolution.

TUESDAY, APRIL 17.

MORNING SESSION.

Simon Flexner: Mechanisms that defend the body from poliomyelitic infection, (*a*) external or extranervous, (*b*) internal or nervous.

T. S. Githens and S. J. Meltzer: The difference in the action of antipyretics according to the species of animals subjected to this action, the state of health of the animals, the height of their normal temperature and the substance employed.

Charles B. Davenport: Heredity and juvenile promise of eminent naval men.

Henry Fairfield Osborn: The causes of the evolution of proportions by mammals.

W. V. King (introduced by L. O. Howard): Sporogony of malaria parasites. Photomicrographs of infected anopheles.

Frank R. Lillie: Sex determinations and sex differentiation in mammals.

Herbert J. Spenden (introduced by W. H. Holmes): Economic contributions of ancient America.

Sylvanus G. Morley (introduced by J. W. Fewkes): The Maya hieroglyphic writing.

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E. E. Barnard: The star in Ophiuchus with great proper motion.

E. E. Barnard: Total lunar eclipse of January 7, 1917.

E. E. Barnard: Measures of the position of the nucleus of the great nebula of Andromeda.

Edwin B. Frost: Recent remarkable changes in a nebula.

AFTERNOON SESSION.

The work of the National Research Council: George E. Hale, chairman National Research Council; Charles D. Walcott, chairman military committee; Robert Andrews Milliken, chairman physics committee; Marston Taylor Bogert, chairman chemistry committee; Victor Clarence Vaughan, chairman committee on medicine and hygiene.

WEDNESDAY, APRIL 18.

Second William Ellery Hale lecture, by Edwin Grant Conklin, professor of zoology, Princeton University. Subject, Methods and causes of organic evolution.

AUTUMN MEETING.

The autumn meeting of the academy was held in the Engineering Building of the University of Pennsylvania at Philadelphia, on November 20 and 21, 1917.

Fifty-six members were present, as follows:

Abbot, C. G.
Bailey, L. H.
Bogert, M. T.
Carty, J. J.
Clarke, F. W.
Clarke, J. M.
Conklin, E. G.
Coulter, J. M.
Cross, Whitman
Davenport, Charles B.
Day, Arthur L.
Donaldson, H. H.
Farlow, W. G.
Flexner, Simon
Hale, George E.
Hall, E. H.
Halsted, William Stewart
Harper, R. A.
Harrison, Ross G.
Holmes, William H.
Howard, L. O.
Howe, H. M.
Howell, W. H.
Iddings, J. P.
Jennings, H. S.
Kasner, Edward
Leuschner, Armin O.
Levene, P. A. T.
Loeb, Jacques
Lusk, Graham
Mayer, A. G.
Meltzer, S. J.
Mendel, Lafayette B.
Millikan, R. A.
Morgan, T. H.
Morse, E. S.
Nichols, E. L.
Noyes, A. A.
Osborn, H. F.
Pearl, Raymond
Pupin, Michael I.
Reid, H. Fielding
Schlesinger, Frank
Scott, William B.
Smith, Alexander
Smith, Edgar F.
Smith, Erwin F.
Stratton, Samuel Wesley
Thomson, Elihu
Thorndike, Edward L.
Walcott, Charles D.
Welch, William H.
Wheeler, William M.
White, David
White, H. S.
Wilson, Edmund B.

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BUSINESS SESSIONS.

ANNOUNCEMENT OF DEATHS.

The president announced the following deaths since the last annual meeting of the academy:

Arnold Hague, elected 1885, died May 15, 1917.
J. M. Crafts, elected 1872, died June 21, 1917.
William B. Clark, elected 1908, died July 27, 1917.
Franklin P. Mall, elected 1907, died November 17, 1917.
Adolf von Baeyer, foreign associate, elected 1898, died August, 1917.

BIOGRAPHICAL MEMOIRS.

The president also announced the assignment of the following biographical memoirs: Arnold Hague, to J. P. Iddings; William Bullock Clark, to John M. Clarke; and Franklin P. Mall, to R. G. Harrison.

EDITORIAL BOARD.

Under the rules of the academy the following members of the editorial board of the Proceedings retire December 1, 1917: E. G. Conklin, C. B. Davenport, E. B. Frost, W. H. Holmes, and E. H. Moore. The home secretary announced that the following members had been appointed by the council to serve in their places until December 1, 1920: Jacques Loeb, W. M. Wheeler, E. B. Frost, E. L. Thorndike, and E. H. Moore. E. B. Wilson was reappointed managing editor for one year.

SECTION AND COMMITTEE ANNOUNCEMENTS.

Section of Anthropology and Psychology: J. Walter Fewkes, to succeed J. McKeen Cabbell.

Program committee: Edward L. Thorndike, to succeed J. McKeen Cabbell.

REPORT OF THE EDITORIAL BOARD.

As we have now completed the third volume of our Proceedings it seems to me opportune to circulate some statistics relative to the Proceedings and covering its whole existence. You will notice in the summary of articles according to subjects that mathematics and astronomy have recently dropped off a little, although their totals remain satisfactory. Physics has come to a satisfactory total, mainly by the large number of articles last year. Chemistry, considering the amount of chemical work in this country relative to work in other lines, has not a satisfactory total, nor has the number of articles been satisfactory in either of the last two years. Two of the articles in 1915 in chemistry might have been called agriculture. It has seemed best to introduce agriculture as a special topic, although it is clear that the make-up of the academy is such that we can hardly expect a very large number of articles in agriculture, except on general grounds. Geology, though having a bad start, has satisfactory totals, and the same is true of zoology and genetics. Botany, however, has always been low, perhaps because of a relatively smaller output in botany in this country. Physiology and pathology seem to me hardly satisfactory in their totals, pathology in particular having very few articles in comparison with the great activity in that subject in this country. Anthropology

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has perhaps been particularly hard hit by the war, and psychology has always been small in the Proceedings, possibly because there is not a proportionate degree of activity in scientific psychology in this country.

I should be glad if this summary may be of some help to the editors in pointing out those branches in which special effort should be made to have the Proceedings properly representative of American research. The war period is one in which research will probably suffer seriously, and for that reason is a period in which more than ordinary discrimination and effort must be used to keep the Proceedings up to standard and truly representative. The action of this board in voting that the size of the Proceedings should not be materially diminished is an indication that the board feels that particularly during the war period the Proceedings should be kept up. Indeed, if the Proceedings is carefully and conscientiously maintained in standard and size during the period of the war, it would almost seem as though no efforts after the war would be necessary other than those of eliminating superabundant material and thus automatically raising the standard.

You will see from the summary of institutions which have contributed more than three articles that there has been a great diminution in receipts from the University of Chicago, University of California, Johns Hopkins University, and the Rockefeller Institute. As the number of articles has not varied greatly from year to year, this diminution has been made up in the main by straggling articles from all sorts of places. The Proceedings certainly should welcome this increase in the distribution of its articles. It shows for one thing that the Proceedings is becoming representative of American research. It does seem, however, as though the number of articles received from the University of Chicago, University of California (including the Lick Observatory), and from the Rockefeller Institute are disproportionately small this year, and it may be feared that unless these leading institutions do better in the future we must infer that while the Proceedings is growing in representative character the country over, it is losing sadly in obtaining the best work of the best men in the best institutions and is thus in one way becoming far less representative than it should be.

The statistics of articles by members of the academy as compared with articles by nonmembers are interesting mainly in showing a progressive diminution in the percentage of articles by members, despite the increase in membership of the academy. If there are obstacles which can be removed and which hinder members of the academy from printing in the Proceedings, would it not be well to make efforts to remove them? The academy represents the highest point in American research, and if the Proceedings should actually contain articles representing the totality of the investigations of members of the academy it would thereby become largely representative of all American research and of very high grade, and furthermore it would be more truly the Proceedings of the academy in the sense that corresponding publications of foreign academies are representative of their research.

The average length of articles has varied very little and is satisfactory.

The vote in regard to changing the style of headings for articles and the size of the type in the Proceedings was almost unanimous in favor—as a war-economy measure—of printing the Proceedings in 10-point type and of using the text type instead of Cheltenham for the headings, consequently your chairman and managing editor have ordered the changes made beginning with the January issue.

E. B. WILSON, *Managing Editor.*

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INSTITUTIONS WHICH HAVE CONTRIBUTED THREE OR MORE ARTICLES TO THE PROCEEDINGS EACH YEAR.

Institutions.	1915	1916	1917	Institutions.	1915	1916	1917
Carnegie Institution	34	29	32	United States Geological Survey	3	4	.....
University of Chicago	20	12	6	Maine Agricultural Experiment Station	.....	5	.....
University of California	17	7	.....	Brown University	.....	5	9
Harvard University	16	31	26	Massachusetts Institute of Technology	.....	5	.....
Johns Hopkins	11	11	4	Observatorio Nacional Argentine	.....	3	.....
Rockefeller Institute	11	4	4	United States Department of Agriculture	.....	.....	4
University of Illinois	8	4	5	University of Virginia	.....	.....	4
Yale University	6	7	7	General Electric Co	.....	.....	4
Princeton University	5	5	5	Columbia University	.....	.....	3
Smithsonian Institution	4	4	.....				
United States National Museum	4	.....	.....				
Stanford University	4	.....	.....				
American Museum of Natural History	4	.....	3				

SUMMARY OF THE ARTICLES WHICH HAVE APPEARED IN THE FIRST THREE VOLUMES OF THE PROCEEDINGS.

Subject.	1915	1916	1917	Total.
Mathematics	21	20	13	54
Astronomy	31	29	17	77
Physics and engineering	7	23	32	62
Chemistry	21	15	12	48
Agriculture	0	0	4	4
Geology and paleontology, including oceanography, mineralogy, and petrology	10	33	18	61
Botany	4	9	5	18
Zoology	15	20	27	62
Genetics	17	10	11	38
Physiology and pathology	24	13	18	55
Anthropology and psychology	15	14	5	34
Total	165	186	162	513
Articles by members	55	63	49	167
Articles by nonmembers	110	123	113	446

AUDITING COMMITTEE.

The president appointed an auditing committee consisting of C. G. Abbot (chairman), W. F. Durand, and A. L. Day.

ANNUAL TABLES OF CONSTANTS.

Considering the request of Mr. Julius Stieglitz, member for the United States of the International Commission on Annual Tables of Constants and Numerical Data, asking on behalf of the commisison for a continuation of the support of the academy in the publication

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of the tables under the patronage of the International Association of Academies, the following grant was approved:

That a grant of $200, or such portion of it as may be approved by the president and foreign secretary, be made from the general funds of the academy as a subvention in support of the annual tables of constants published under the patronage of the International Association of Academies.

ENGINEERING SECTION.

The following minute from the council relating to the development of a section of engineering was approved:

It is the sense of the council that the home secretary be requested to obtain suggestions from members of the academy of names of engineers to be considered by the council for nomination at the next annual meeting.

CLASSIFICATION OF SCIENTIFIC MEN FOR WAR SERVICE.

Considering a communication from the American Association of University Professors, requesting cooperation in the classification of scientific men for war service, the following recommendations were adopted by the academy and forwarded to the Secretary of War:

The National Academy of Sciences, being convinced that such action is absolutely necessary for the successful prosecution of the war, urges that the privilege of enlistment granted to the medical profession, including students and internes, under orders of the War Department, office of the Surgeon General, dated September 4, 1917, if not already provided for by the intended interpretation of the new classification of drafted men, be expanded to embrace men in the following scientific professions, including junior, senior, and graduate students in educational or research institutions, so that all such men may be privileged to enroll in the appropriate reserve corps or in such branch of the service as in your judgment will enable them to make their special knowledge and training of greatest use to their country.

Agriculturists.
Anatomists.
Astronomers.
Bacteriologists.
Biologists.
Botanists.
Chemists.
Chemical engineers.
Civil engineers.
Electrical engineers.
Geologists.
Mechanical engineers.
Metallurgical engineers.
Meteorologists.
Mining engineers.
Pathologists.
Physicists.
Physiologists.
Psychologists.
Zoologists.
Experts in public health, hygiene, and sanitation.

The academy recommends that, pending the working out of the details requisite for the establishment of these privileges, the pro-

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fessional men affected by the same be placed in Class III of the new classification of drafted men.

The purpose of the establishment of the academy by special act of Congress, as stated in its charter, was to create an organization whose duty it should be to advise the Government on scientific matters. It would be recreant to this duty, therefore, if it failed to point out the urgent need of the action recommended above, and to express its firm conviction that to win this war our scientifically trained men must be used to do the work which they alone can do. The inclusion of such men in Class I of the new draft classification would result in a wholly disproportionate loss of national efficiency in comparison with the size of the army so created. Of the many grievous losses sustained by our allies, the one felt most keenly, according to their own oft-repeated statements, is that of the scientific men who went to the front at the first call, and laid down their lives there.

These recommendations are prompted by the following further considerations:

1. The failure of many of the district boards created by the selective-draft legislation, to recognize the necessity of retaining these scientific men for the kind of work for which they have been especially trained.

2. The retention of many scientific men as privates in the training camps of the National Army, who it is believed could render much more valuable service to their country if employed in the lines of their special profession.

3. The eager patriotism of our university men has led large numbers to enlist in the rank and file of our Army and Navy, and has correspondingly thinned the ranks of students, teachers, and investigators. There is immediate danger that without specific provision to the contrary, the universities will lack the teachers and students necessary to insure a steady flow of new effectives to the industrial and military fronts.

4. Many industrial establishments now of the utmost importance for the security and defense of our country are seriously impeded in their work by the fact that numbers of their highly trained scientists already have either been drafted or have volunteered for service and sought commissions for fear that they would be drafted and assigned to military duties of such a character as would not enable them to render to their country the greatest service of which they were capable. The result of this has been to reduce the working force of scientists in such establishments to the point where, unless further withdrawals are made with the greatest care, many of these plants will have to close their doors and go out of business.

It is respectfully urged that professional students be instructed to enlist in the appropriate reserve corps of the service, with the

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privilege of furlough for the completion of their training, similar to that adopted to secure the most efficient service of the medical men, and that this opportunity be granted only to men of proven ability. Students, teachers, and research men should be given the opportunity of enlistment with the privilege of furlough or discharge subject to the recommendations of the presidents of the institutions concerned. For others, the decision should rest with the authorities designated by the Secretary of War.

In case the academy can be of assistance in working out any of the details involved in the foregoing recommendations, it will esteem it both an honor and a patriotic duty to cooperate with whomsoever you may designate.

DECEMBER 20, 1917.

ARTHUR L. DAY,

Home Secretary National Academy of Sciences,

Washington, D. C.

DEAR SIR: This will acknowledge receipt of your letter of the 12th instant, addressed to the Secretary of War and referred to this office, transmitting a communication from the committee of the National Academy of Sciences on the classification of men for war service, recommending that provision be made for the enlistment of certain classes of scientific students in appropriate reserve corps and suggesting the importance of this Government profiting by the mistakes made by our allies at the beginning of the war in failing adequately to provide for the conservation of their scientific knowledge.

The recommendations of your committee have been carefully considered, and we are in entire accord in the conviction that every practicable provision should be made by which the country will be assured of the maximum benefit of the scientific knowledge of its citizens, and through which advanced students in certain scientific courses may be enabled to complete their training, to the end that they may be more able to serve our country.

In fact, the wisdom of this selection and distribution of the young men of the Nation in the particular capacities for which they are best fitted was recognized by Congress in the enactment of the selective-service law. This law, as it is being administered under the regulations prescribed by the President, seeks to select those men for present military service who can be spared best from their civil capacities and by such selection to disturb as little as possible consistent with the exigencies of the emergency the industrial, scientific, and economic interests of the Nation.

In this connection, and especially referring to the provisions which have been made for enabling young men pursuing special courses of scientific training to continue their studies, your attention is invited to the following excerpts from section 151 of the regulations as amended:

> "(*b*) Under such regulations as the Surgeon General may prescribe and upon receiving permission from the Surgeon General to do so, any medical student, hospital intern, dentist, dental student, veterinarian, or veterinary student may enlist in the Enlisted Reserve Corps of the Medical Department, and thereafter upon presentation by the registrant to his local board of a certificate of a commissioned officer of the Medical Department of the Army that he has been so enlisted, such certificate shall be filed with the questionnaire and the registrant shall be placed in class V on the ground that he is in the military service of the United States. * * *

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"(*d*) Under such regulations as the Chief of Engineers may prescribe, a proportion of the students, as named by the school faculty, pursuing an engineering course in one of the approved technical engineering schools listed in the War Department may enlist in the Enlisted Reserve Corps of the Engineer Department and thereafter, upon presentation by the registrant to his local board of a certificate of enlistment, such certificate shall be filed with the questionnaire and the registrant shall be placed in class V on the ground that he is in the military service of the United States."

Even a cursory examination of these provisions will disclose their wide application. The heads of the Medical and Engineering Departments, two of the important scientific branches of the Military Establishment, have been given almost unlimited discretion in selecting and providing for the enlistment in the appropriate reserve corps of students in the sciences they represent. By granting this authority the principle of selective system is carried to its logical conclusion; and the officers particularly learned in special lines are enabled to apply their peculiar knowledge in formulating rules which, in their opinion, best subserve the scientific and military interests of the Nation. It will be noticed that in this way a large proportion of the classes of students mentioned in the communication from the committee of the National Academy of Sciences has been provided for in present regulations.

In considering the question of permitting students to pursue their studies to graduation, it should be remembered that a large per cent of the college and university students of the country are included within the draft age, and, in view of the present urgent need for young and healthy men for the Army, it manifestly would be unwise to accord to all students the privilege of completing their courses. Modern war can not be waged without large armies, and unfortunately large armies can not be raised without great hardship. The problem, therefore, reduces itself to a selection of certain classes of students pursuing courses of sciences deemed most essential to the fundamental needs of the Nation in the present emergency. This has been done, in so far as there are appropriate reserve corps available, and as the necessity for creating new reserve corps becomes apparent, the proper steps will be taken toward their organization.

Referring to the suggestion that many district boards have failed to recognize the necessity of leaving scientific men in the work for which they have been especially trained, and that many industrial establishments of the utmost importance to the security and defense of our country are being seriously embarrassed on that account, attention is respectfully invited to the new Selective Service Regulations. By these regulations, all registrants will be definitely classified within the next few months and ample provision has been made therein to insure that scientific men actively engaged in industries of the character mentioned above will be placed in a deferred class. (Secs. 81–85–88.)

It is, of course, evident that the selective-service law can not entirely prevent the loss to such industries of men who volunteer or seek commissions "for fear that they would be drafted and assigned to military duties of such a character as would not enable them to render to their country the greatest service of which they are capable." Just this situation has, however, been provided for so far as practicable (1) by removing the uneasiness of registrants by a definite classification; (2) by foreclosing the privilege of enlistment to registrants within a current quota of their local boards, and thus forcing them to submit to an orderly selection; and (3) by securing the necessary data in their questionnaires for enabling the Government when necessary to assign them to branches of the Army in which they are especially qualified to serve. In this

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connection your attention is invited to pages 4 and 5 of the questionnaire and section 149 of the Selective Service Regulations.

Allow me to express my appreciation to your committee for its communication and to invite further recommendations, if, in the light of the above facts and the Selective Service Regulations, additional suggestions for the perfection of these regulations are deemed necessary.

Very truly, yours,

E. H. CROWDER, *Provost Marshal General.*

REPORT OF COMMITTEE ON COMSTOCK FUND.

The following report from the committee of the Comstock fund was adopted:

The committee on the Comstock fund, at a meeting held on November 20, 1917, decided to recommend to the academy that the second award of the Comstock prize of $1,500 be made to Samuel Jackson Barnett for his investigation on magnetization by rotation.

In this research certain very important and fundamental facts are established: (1) That there are, within the iron, currents of negative electricity in orbital revolution; (2) that these gyrostatic systems have inertia and are capable of definite orientation or arrangement by the rotation of the body without the action of any external magnetic field; and (3) that such orientation manifests itself as a magnetization of the body as a whole.

This experiment is of the utmost significance in the theory of magnetism and is far reaching in its bearings upon our views of the ultimate constitution of matter.

EDW. L. NICHOLS, *Chairman.*

AMENDMENTS TO CONSTITUTION AND RULES.

The following amendment to the constitution, Article III, section 1, reported from the council and returned to the academy from the committee of the whole with favorable recommendation was adopted:

That the academy shall hold one stated meeting, called the annual meeting in April of each year in the city of Washington, and another stated meeting, called the autumn meeting, at a place to be determined by the council. The council shall also have power to fix the date of each meeting.

The following rule, III, 1, recommended by the council was adopted:

The annual meeting of the academy shall begin on the fourth Monday in April.

The committee of the whole, upon recommendation of the council, considered the following amendment to the constitution and reported it for favorable action by the academy at the annual meeting in 1918:

That the constitution be amended by substituting in Article II, section 1, line 3 (Report, 1916), the word "four" for the word "six" so that it will read * * * "for a term of four years" * * * to take effect on the expiration of the term of office of the present incumbents or in case of a vacancy.

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Article II, section 1, when amended to read:

SECTION 1. The officers of the academy shall be a president, a vice president, a foreign secretary, a home secretary, and a treasurer, all of whom shall be elected for a term of four years by a majority of votes present, at the first stated meeting after the expiration of the current terms, provided that existing officers retain their places until their successors are elected. In case of a vacancy the election for four years shall be held in the same manner at the meeting when such vacancy occurs, or at the next stated meeting thereafter, as the academy may direct. A vacancy in the office of treasurer or home secretary may, however, be filled by appointment of the president of the academy until the next stated meeting of the academy.

THE WATSON FUND.

The following motion relating to the administration of the Watson fund, adopted at the business session of April 16, 1917, which was found to conflict with a clause in the will of James Craig Watson, was rescinded:

That the trustees of the Watson fund be authorized to act for the Academy in the approval of grants and to report such action to the academy at the next stated meeting.

PROCEEDINGS DEFICIT.

Under business from the council a statement of the financial condition of the Proceedings was laid before the academy in considerable detail. To meet the anticipated deficit of $5,000 in the conduct of the Proceedings to July 1, 1918, Mr. Pupin announced that three members of the academy had agreed to be responsible for one-half of this sum. The chairman of the finance committee, Mr. Davenport, reported that his committee had raised $1,185 for the same purpose. After discussion by the president, the chairman of the editorial board, and Messrs. Hale, Meltzer, John M. Clarke, and the home secretary, it appeared to be the sense of the meeting that further financial arrangements be left in the hands of the finance committee.

The academy further considered securing additional subscriptions for the Proceedings, and upon the recommendation of the council adopted the following resolution:

That the editorial board recommend to the academy that each member of the academy be responsible for one subscription to the Proceedings, to be paid for by the member or by a subscriber.

CONTRIBUTIONS TO THE SUPPORT OF THE PROCEEDINGS.

The finance committee of the Proceedings begs to report that it received the following contributions, totaling $1,185:

George R. Agassiz, 14 Ashburton Place, Boston	$100
N. L. Britton, New York Botanical Garden, New York	100
John J. Carty, American Telegraph & Telephone Co., New York, N. Y.	100

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C. R. Crane, Chicago, Ill	$125
H. H. Donaldson, Wistar Institute, Philadelphia	25
E. H. Hall, Cambridge, Mass	25
Mrs. E. H. Harriman, 1 East Sixty-ninth Street, New York, N. Y	100
Julius Rosenwald, Chicago, Ill	125
Henry L. Higginson, 44 State Street, Boston, Mass	100
Anonymous, through Frank Lillie, Chicago, Ill	125
Graham Lusk, Cornell Medical College, New York, N. Y	50
S. J. Meltzer, Rockefeller Institute, New York	10
Henry F. Osborn, American Museum of Natural History, New York, N. Y.	25
Harold H. Swift, Chicago, Ill	125
Elihu Thompson, Lynn, Mass	25
J. F. Kemp, 219 Lynch Building, Tulsa, Okla	25
	1,185

C. D. DAVENPORT, *Chairman.*
FRANK R. LILLIE.
RAYMOND PEARL.

NOVEMBER 15, 1917.

The following resolution was unanimously adopted:

That the home secretary be requested to transmit the thanks of the academy to the provost of the University of Pennsylvania, the president of the American Philosophical Society, the president of the Academy of Natural Sciences of Philadelphia, and the members of the local committee for the courtesies extended to the members of the National Academy of Sciences at the autumn meeting, 1917.

SCIENTIFIC SESSIONS.

MEETING OF NOVEMBER 20–21, 1917.

TUESDAY, NOVEMBER 20.

Edwin F. Smith, Bureau of Plant Industry, United States Department of Agriculture: The wheat problem of the United States.

Liberty H. Bailey: The modern systematist.

Bradley M. Davis, University of Pennsylvania: A criticism of the evidence for the mutation theory of De Vries from the behavior of Œnothera in crosses and in selfed lines. (By invitation.)

Jacques Loeb, Rockefeller Institute: The chemical mechanism of regeneration.

Henry H. Donaldson, the Wistar Institute: A comparison of growth changes in the nervous system of the rat with the corresponding changes in man.

Charles B. Davenport, Station for Experimental Evolution, Carnegie Institution: Hereditary tendency to form nerve tumors.

Lafayette B. Mendel and Thomas B. Osborne, Yale University: Food hormones or vitamines in some animal tissues. (To be presented by L. B. Mendel.)

Edgar F. Smith and Walter K. Van Haagen, University of Pennsylvania: The atomic weight of boron.

Samuel J. Meltzer and John Auer, Rockefeller Institute: The effect of intravenous injection of magnesium sulphate upon tetanus—with a lantern slide demonstration by J. Auer. (By invitation.)

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Simon Flexner, Rockefeller Institute: Chemotherapy of spirochetal infections. (For Dr. Jacobs and Dr. Brown.)

Clarence E. McClung, University of Pennsylvania: Possible action of the sex—determining mechanism. (By invitation.)

Thomas H. Morgan, Columbia University: The cause of Mosaics and Gynandromorphs in Drosophila.

Herbert E. Ives, Physical Laboratory—The United Gas Improvement Co.: Spectrum analysis by differential persistence of vision. (By invitation.)

WEDNESDAY, NOVEMBER 21.

Charles G. Abbot, Smithsonian Astrophysical Observatory: The atmosphere and terrestrial radiation.

Edward Kasner, Columbia University: Geometric aspects of the theory of heat.

Oliver E. Glenn, University of Pennsylvania: Invariants which are functions of parameters of the transformation. (By invitation.)

Edwin H. Hall, Harvard University: The validity of the thermoelectric equation $P=T\frac{d\,v.}{d\,T}$.

Edwin H. Hall, Harvard University: A thermoelectric diagram on the P. V. plane.

William B. Scott, Princeton University: The Astrapotheria of the Patagonian Miocene.

Henry F. Osborn, American Museum of Natural History: Evolution of the Titanotheres; Final Conclusions.

Eric Doolittle, University of Pennsylvania: Study of the motions of 48 double stars. (By invitation.)

Gustav Strömberg, Mount Wilson Solar Observatory, Carnegie Institution: (Introduced by Walter S. Adams.) A determination of the solar motion and of stream motion based on absolute magnitudes. (Read by Prof. Hale.)

Armin O. Leuschner, University of California: On finite velocity of gravitation as a possible factor in stellar evolution.

Alfred G. Mayer, marine laboratory, Carnegie Institution: The coral reefs of Tutuila, Samoa.

William M. Davis, Harvard University: The subsidence of volcanic islands.

William M. Davis, Harvard University: A duty of the International Association of Academies.

William H. Holmes, United States National Museum: The work of the anthropology committee of the National Research Council.

Edward L. Thorndike, Columbia University: The work of the psychological committee of the National Research Council.

George E. Hale, Mount Wilson Solar Observatory, Carnegie Institution: The work of the National Research Council.

Louis V. Pirrson, Yale University; Biographical memoir of James D. Dana. (Read by title.)

William J. Humphreys, United States Weather Bureau: (Introduced by A. L. Day.) Biographical memoir of Cleveland Abbe. (Read by title.)

E. H. Hall: Biographical memoir of Benjamin Osgood Pierce.

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DECEASED MEMBERS.

WILLIAM BULLOCK CLARK.

Dr. William Bullock Clark, professor of geology in the Johns Hopkins University, eminent for his contributions to geology, died suddenly from apoplexy on July 27 at his summer home at North Haven, Me.

William Bullock Clark was born at Brattleboro, Vt., December 15, 1860. His parents were Barna A. and Helen (Bullock) Clark. Among his early ancestors were Thomas Clarke, who came to Plymouth, Mass., in the ship *Ann* in 1623, and who was several times elected deputy to the general court of Plymouth Colony; Richard Bullock, who came to Salem, Mass., in 1643; John Howland, a member of council, assistant to the governor, and several times deputy to the general court of Plymouth Colony, who came to Plymouth in the *Mayflower* in 1620; John Tilly, who likewise came in the *Mayflower*; and John Gorham, captain of Massachusetts troops in King Philip's War. Among later ancestors were William Bullock, colonel of Massachusetts troops in the French and Indian War, and Daniel Stewart, a minuteman at the battle of Lexington in 1775.

Prof. Clark studied under private tutors and at the Brattleboro High School, from which he graduated in 1879. He entered Amherst College in the autumn of 1880 and graduated with the degree of A.B. in 1884. He immediately went to Germany and from 1884 to 1887 pursued geological studies at the University of Munich, from which he received the degree of doctor of philosophy in 1887. Subsequently he studied at Berlin and London, spending much time in the field with members of the geological surveys of Prussia and Great Britain.

Before leaving Munich Dr. Clark was offered and accepted the position of instructor in the Johns Hopkins University. He was instructor from 1887 to 1889, associate from 1889 to 1892, associate professor from 1892 to 1894, when he became professor of geology and head of the department. He was for a long time a member of the academic council—the governing body of the university—and always took a very active interest in its affairs, acting as one of the committee of administration while the university was without a president.

In 1888 he was also appointed an assistant geologist on the United States Geological Survey and detailed for work on the Cretaceous and Tertiary formations of the Atlantic coastal plain. At the same time he was requested to prepare the correlation bulletin on the Eocene, one of a series of reports which were presented to the Inter-

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national Geological Congress in Washington in 1891. Prof. Clark spent the summer of 1889 in a study of the Eocene deposits of the far West while the remaining period was occupied in the investigation of the Eocene formations of the Atlantic border. He was advanced to geologist on the staff of the United States Geological Survey in 1894 and held that position until 1907, from which time he acted as cooperating geologist.

Prof. Clark organized the Maryland State Weather Service in 1892, of which he was appointed the director. He held the position continuously to the time of his death. In 1896 he organized the Maryland Geological Survey, and was State geologist from the establishment of that bureau. The geological survey was enlarged in scope in 1898 by the addition of a highway division, which was instructed to investigate and report on the conditions of the roads of the State and the best means for their improvement, and Prof. Clark and his associates through their publications and addresses aroused much interest in the subject throughout the State. In 1904 the duties of the highway division were much increased by the appropriation of $200,000 annually, to be met by a similar amount from the counties for the building of State-aid roads by the survey. A sum exceeding $200,000 was also subsequently appropriated for the building of State-aid roads by the survey, at the expense of the State alone, of a highway connecting Baltimore and Washington. The duties of the highway division were transferred in 1910 to a newly organized State roads commission, of which Prof. Clark was made a member and which position he held until 1914. Nearly $2,000,000 had been expended, however, by the State geological survey in the supervision and building of roads up to the date of the transfer.

Under an act of legislature passed in 1900 Prof. Clark was appointed commissioner for Maryland by the governor to represent the State in the resurvey of the Maryland-Pennsylvania boundary, commonly known as the Mason and Dixon Line. This survey was completed four years later and an elaborate report prepared. In 1906 he was made a member of the Maryland State board of Forestry and elected as its executive officer, which position he held at the time of his death. The governor appointed him in 1908 a member of the State conservation commission.

Prof. Clark organized and directed the preparation of the official State exhibits of Maryland mineral resources at the Buffalo, Charleston, St. Louis, Jamestown, and San Francisco Expositions in 1901, 1902, 1904, 1907, and 1915. These exhibits attracted much attention at the time and received a large number of conspicuous awards. These exhibits have been permanently installed as a State mineral exhibit at the statehouse in Annapolis.

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When President Roosevelt invited the governors of the States to a conference on conservation at the White House in May, 1908, it was arranged that each governor should appoint three advisers to accompany him. Prof. Clark was one of the Maryland advisers and took part in the conference.

After the great Baltimore fire in 1904 the mayor of the city appointed Prof. Clark a member of an emergency committee to prepare plans for the rehabilitation of the burned district, and for several months he served as vice chairman of the important subcommittee on streets, parks, and docks, whose plans resulted in the great changes subsequently carried out. The following year he was appointed by the mayor a member of a committee to devise a plan for a sewerage system for the city, which resulted in the building of the present modern system of sewers. Again, in 1909, the mayor also appointed him a member of a committee for devising a plan for the development of a civic center for Baltimore.

From 1901 Prof. Clark was president of the Henry Watson Children's Aid Society, of Baltimore, and was a delegate to the White House conference called by President Roosevelt in February, 1909, to consider the subject of the dependent child. He was also a member of the executive committee of the State tuberculosis association and a vice president and chairman of the executive committee of the federated charities of Baltimore.

Numerous scientific societies elected him to membership, among them the National Academy of Sciences, of which he was chairman of the geological section, the American Philosophical Society, the Philadelphia Academy of Natural Sciences, the American Academy of Arts and Sciences, the Deutsche Geologische Gesellschaft, the Washington Academy of Sciences, Paleontologische Gesellschaft, and the American Association for the Advancement of Science. He was councillor and treasurer of the Geological Society of America at the time of his death. In 1904 he was elected a foreign correspondent of the Geological Society of London. He was also president of the Association of State Geologists. Amherst conferred on him the degree of LL. D. in 1908. He had numerous offers from other institutions, perhaps the most important being the professorship and head of the department of geology at Harvard University, but all of these were refused, and his devotion to Hopkins and the ideals for which it stood was unswerving.

At the time of the International Geological Congress in St. Petersburg in 1897 Prof. Clark was an official delegate from the United States and spent several months in an extended trip through Russia and its Provinces. In 1906 he spent the summer on an expedition to central Alaska, visiting the region to the north of Prince William

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Sound. He traveled extensively in western America and Mexico, reaching distant portions of the western Sierra Madre district.

With the outbreak of the war Prof. Clark became actively interested in problems of defense and economic preparedness. He was appointed a member of the National Research Council and was chairman of the subcommittee on road materials and a member of the committee on camp sites and water supplies. He was also chairman of the committee on highways and natural resources of the Maryland Council of Defense.

Prof. Clark made numerous contributions to geological literature, his work being confined largely to the Cretaceous and Tertiary formations of the Atlantic coastal plain and the Carboniferous deposits of the central Appalachian region. Prof. Clark's chief paleontological interest was centered in the Echinoidea, to the elucidation of which group he published several monographs. One of his monuments will be the series of reports of the Maryland Geological Survey, which set a new standard for State publications, both as to subject matter and bookmaking. The systematic reports in which he was most interested will be of perennial service to science.

He was a member of numerous clubs, including the University, Maryland, of which he was a vice president, Baltimore Country, Johns Hopkins, and City Clubs, of Baltimore, and the Cosmos Club, of Washington.

He was married October 12, 1892, to Ellen Clarke Strong, daughter of the late Edward A. Strong, of Boston, and had four children—Edward Strong, Helen (who was recently married to Capt. H. Findlay French), Atherton, and Marion, all of whom survive him.

Prof. Clark's administrative ability and professional attainments are largely responsible for the extensive development of Maryland's mineral resources, and his loss will be severely felt in all quarters. He was always keenly interested in the educational value of the work of the various State bureaus which he directed and had just finished writing a geography of Maryland for school-teachers. At the time of his death he was engaged in writing a report on the underground waters of the State and another on the coals.

(Abstract from Science, n. s. Vol. XLVI, No. 1179, p. 104.)

ARNOLD HAGUE.

Arnold Hague, the able geologist and a man of rare personal gifts, was born in Boston December 3, 1840, and died at his home in Washington May 14, 1917. The immediate cause of his death was cerebral hemorrhage, and was undoubtedly hastened by his recent fall in Albany while attending a meeting of the Geological Society of America. For nearly 50 years he was prominent in the geological

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affairs of the country. His parents, the Rev. Dr. William Hague, a noted clergyman and writer, and Mary Bowditch (Moriarty) Hague, lived in Boston during his youth. There his education began, but later he attended the Albany Academy.

James D. Hague, his elder brother, studied mining engineering at the Lawrence Scientific School of Harvard, and Arnold may have acquired from him his taste for geology. At the Sheffield Scientific School of Yale, where Arnold Hague graduated (Ph. B.) in 1863, he met as classmate Clarence King, who had much to do with his career. Three years in succession Hague studied in Europe at the Universities of Göttingen and Heidelberg and the Freiberg School of Mines. While in Bunsen's laboratory he devoted himself chiefly to chemistry and mineralogy. The spring of 1865 found him in Freiberg, where he met S. F. Emmons. They were especially congenial, and with the same bent they soon became and continued through life devoted friends and colleagues. Hague in his excellent memoir of Emmons tells much of himself. Indeed, much of that loving tribute to his friend reads like an autobiography. He writes: "I was always ready to lay aside metallurgical studies for field geology. Together we took all the week-end excursions with dear old Bernhard von Cotta, visiting many parts of Saxony and studying petrology as laid down in that now antiquated textbook, Cotta's 'Die Gesteinlehre' (Zweite Auflage, 1862). Many an evening Emmons and I spent together over the map of Saxony, acquiring our initiative experience in geological cartography, which later stood us in good service. Both came to realize the influence of Cotta upon our future careers, as he gave us much of his time. In this way, during these few months of German student life, was formed a friendship that always endured."

Hague returned to his home in Boston in December, 1866, and soon received from his friend, Clarence King, an offer to join in the geological exploration of the fortieth parallel, which King was just succeeding in carrying through Congress without the customary delay. Hague lost no time in bringing Emmons to the attention of King, who secured him, at first as a volunteer, for the fortieth parallel survey. Work began on the Pacific coast in 1867, and the party went thither by way of Panama. The only other available route was by Wells, Fargo & Co.'s overland stage, a tedious, not to say dangerous, journey.

Hague and Emmons had separate parties in the field, and King, with his own camping outfit and greater freedom of motion, conducted special investigations over the whole region, all parties meeting frequently for conference. The topographic and geologic surveys of a belt 100 miles in width along the proposed route of the Central & Union Pacific Railroad proceeded together from the Humboldt country of western Nevada to the Great Plains east of the Rockies. Field work was finally completed late in the autumn of

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1872, but it should be borne in mind that finished topographic maps on which the areal geology was to be shown, as Hague remarks, were seldom in the hands of the geologists till a year after completing the field work.

After the completion of the field work the final preparation of the report with its accompanying atlas was accomplished in New York, where Mr. King and his two colleagues worked together and lived in ties of closest friendship.

Hague's first scientific publications, "Chemistry of the Washoe Process" and the "Geology of the White Pine District," occurred in 1870, when he was 30 years of age. They grew out of his fortieth parallel work and appeared in Volume III of that organization. The great work, Descriptive Geology, of which Hague and Emmons were joint authors, appeared as Volume II, in 1877. King published Systematic Geology, Volume I, in 1878.

For a comparative study, the fortieth parallel geologists in 1870 visited the Cascade Range. King climbed Mount Shasta; Hague climbed Mount Hood; and Emmons, Mount Rainier. They observed about these lofty volcanoes the first active glaciers noted in the United States, and, using the lavas collected, Hague and Iddings made comparative study of the volcanic rocks of the Cascade Range and the Great Basin.

In 1877 Hague received the appointment as Government geologist of Guatemala, and traveled extensively over the Republic, visiting mines and active volcanic centers. The following year he was engaged by the Chinese Government to examine gold, silver, and lead mines in northern China.

Congress created the bureau of the United States Geological Survey in 1879, thus withdrawing congressional authorization from existing surveys and exploration parties and accomplishing a complete reorganization. Clarence King was appointed the first director, and took the oath of office May 24. Arnold Hague, who had returned to the United States, was appointed a geologist in the United States Geological Survey July 8, 1879, but did not take the oath of office until April 10 of the following year.

Under the new organization he was sent to Nevada to study the geology of the Eureka district. His report, published in 1893, is Monograph 22 of the United States Geological Survey. In 1883 he was made geologist of the Yellowstone National Park. With the aid of a number of able assistants and specialists the general study of the Yellowstone National Park was completed some years ago and the results published as Monograph 32, part 2, leaving part 1 to be prepared as a final report by Mr. Hague. It is to include a special study of the geysers, which engaged his attention for a number of

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years. This work, his last and greatest, Hague leaves practically complete.

Mr. Hague, in addition to his larger reports, has contributed papers to a number of scientific periodicals, especially to this Journal. Among these may be mentioned the "Early Tertiary Volcanoes of the Absaroka Range," delivered as his presidential address before the Geological Society of Washington, and "The origin of the thermal waters in the Yellowstone National Park," his presidential address before the Geological Society of America. His bibliography of scientific papers includes 39 titles, the last of which is the memoir to his life-long and devoted friend, S. F. Emmons, published in 1913 by the National Academy of Sciences.

Hague was a fellow of the Geological Society of America, of which he was president in 1910, of the Geological Society of London, and a member of numerous other scientific societies. In 1885 he was elected to the National Academy of Sciences, of which he was an active member and officer. As a member of the commission appointed at the request of the United States Government by the National Academy of Sciences, he had much to do with the plan for our national forest reserves.

Columbia University honored him with the degree Sc. D. in 1901, and in 1906 he received the degree of LL. D. of the University of Aberdeen. He was vice president of the International Geological Congress at Paris 1900, Stockholm 1910, and Toronto 1913. November 14, 1893, he married Mary Bruce Howe, of New York.

Mr. Hague was not a ready writer nor voluminous, but exact. He aimed more to write well and truly than much. He was a charming host, and there are but few scientific men in America who have had so wide a circle of devoted friends as Arnold Hague.

(Extract by J. S. Diller from the American Journal of Science, Vol. XLIV, July, 1917.)

FRANKLIN PAINE MALL.

Franklin Paine Mall, professor of anatomy in the Johns Hopkins Medical School and director of the department of embryology of the Carnegie Institution of Washington, was born in Belle Plaine, Iowa, September 28, 1862, and died in Baltimore November 17, 1917, from complications following an operation for gallstones. He was the son of Francis and Louise (Miller) Mall, both of German descent. In 1895 he married Mabel Stanley Glover, of Washington, D. C. He is survived by his widow and two daughters.

Dr. Mall's early education was obtained in public and private schools near his home. He graduated in medicine from the University of Michigan in 1883, and then went to Germany, where he

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studied first in Heidelberg, and later under His and Ludwig in Leipzig. Upon his return to America he became a fellow in pathology at the Johns Hopkins University (1886–1888), and instructor in pathology from 1888–89. He then went to Clark University as adjunct professor of vertebrate anatomy (1889–1892). In 1892 he was called to the University of Chicago as professor of anatomy; and finally, when the Johns Hopkins Medical School opened (1893), he undertook the direction of the new department of anatomy, which he continued until the time of his death. In 1915 he was made director of the newly established department of embryology of the Carnegie Institution of Washington.

In science Dr. Mall ranks with the great leaders of his generation, and his work, embodied in 104 publications, leads up to important scientific generalizations. In anatomy he broke away from the study of pure morphology and studied structure from the standpoint of how all the tissues of an organ are adapted to its functions. This work led to the conception that most organs are made up of structural units which are equal in size and function. In embryology he was the first to trace the development of an individual organ from its early embryonic form to its adult state, a type of work which may be summed up with the term *organogenesis*.

The later years of his life were devoted to the organization of the department of embryology of the Carnegie Institution of Washington. In this department was incorporated the large and unique collection of human embryos which owed its origin to 30 years of untiring effort on the part of Dr. Mall. One of the most striking points in his career is that, in these years devoted to the organization of a new institute, he accomplished some of his best scientific work. He finished an exhaustive study of abnormal embryos, and had plans under way for the completion of the study of organogenesis and for the analysis of problems associated with growth, which need for their solution large amounts of material and expert technical assistance.

In addition to his numerous contributions to the development of science, Dr. Mall was a great teacher. He will be remembered as having trained a large group of men who are now prominent in scientific medicine. He was an active force in the reorganization of the American Association of Anatomists, and played a prominent part in the development of scientific publications in this country. He was co-editor and one of the founders of the American Journal of Anatomy and the Anatomical Record; associate editor of the Journal of Morphology; joint editor with Franz Keibel of the Handbuch der Entwicklungsgeschichte des Menschen, published in German and English; and finally he established the Contributions to Embryology, published by the Carnegie Institution of Washington. He was a man

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of rare personality; modest, generous, original, unswervingly devoted to ideals, and possessed of a genius for stimulating thought.

Dr. Mall was a member of the following societies: National Academy of Sciences, Society of Experimental Biology and Medicine, American Philosophical Society, American Association of Anatomists, American Society of Physiologists, American Society of Zoologists, Society of American Naturalists, and the Institute Internationale d'Embryologie. He was also a member of the Commission for Neurological Research, a member of the advisory board of Wistar Institute, president of the American Association of Anatomists (1905–1907), and trustee of the Marine Biological Laboratory, Woods Hole, Mass.

(Extract made from a paper read by Wallace C. Sabine at the Franklin P. Mall memorial meeting held at Johns Hopkins University by George L. Streeter.)

ADOLF VON BAEYER.

The announcement in the Times of September 8 of the death of Prof. Adolf von Baeyer at Starnberg, near Munich, in his eighty-second year, must have come as a shock to his many pupils in this country. It was known to several of us that he had not been in good health for some years, but the quiet life which he led at his beautiful home on the shores of the Starnberger See seemed to benefit his health so much that his sudden decease, even at his advanced age, was quite unexpected. It is questionable whether any teacher or investigator ever exerted a greater influence on the development of chemical science, and especially of organic chemistry, than Baeyer has done, for not only was he a great teacher, whose pupils are to be found in every civilized country, but his researches have also laid many of the foundations on which the amazing structure of modern organic chemistry has been raised. Apart from the interest which always attached to his published work, it is probable that his main influence on chemical thought was due to his magnetic personality and power of imparting to others some of his enthusiasm for discovery.

For many years, and particularly during the period 1880–1900, it was the custom for the large majority of those who wished to come into contact with the later developments of experimental method to attach themselves, for a short time at least, to the laboratories at Munich. The power which Baeyer exercised in connection with the progress of chemistry in Germany can scarcely be better illustrated than by the fact that during these years almost every professor of chemistry in Germany of the first rank was a pupil of Baeyer. Among these we find, for example, the names of E. Bamberger, L.

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Claisen, Th. Curtius, Emil Fischer, Otto Fischer, P. Friedländer. C. Graebe, L. Knorr, C. Liebermann, Victor Meyer, H. v. Pechmann, J. Thiele, and R. Wilstätter.

Baeyer's influence on the development of chemical industry, and especially of the color industry, was not less remarkable, for in every works were to be found such men as Caro and Duisberg, Homolka, and Weinberg, and a host of others who had learned their chemistry and acquired their methods of research in the laboratories at Munich. If inquiry is made into the reason for the wide influence which Baeyer has exerted on chemical thought, it will be universally agreed that this has been due in the main to his extraordinary enthusiasm for research and the keen joy which he felt and expressed when he had succeeded in producing some new substance of importance which he had probably been seeking for many months, and possibly for years. On such occasions he used to walk about the laboratories beaming with delight and discuss his latest discovery and its probable consequences with his assistants and advanced pupils. His enthusiasm fired the enthusiasm of his hearers, and unquestionably did much to awaken and stimulate the desire to make discoveries and achieve something perhaps of equal importance. Baeyer was essentially an experimenter, and had little real interest in the development of new theories, although some of his views, such, for example, as those on the constitution of benzine, the structure of oxonium salts, the cause of color in the triphenylmenthane series, and the mechanism of the formation of sugar in the plant, were valuable contributions to theory, and his well-known "Spannungs Theorie" was a brilliant conception of real value in connection with stability in ring structures.

It was Baeyer's habit to adjourn to his private laboratory directly after his early morning lecture, for perhaps an hour, in order to carry out any experiments which had occurred to him after the close of the previous day's work and to discuss the day's program with his assistant. He would then walk through the research laboratories and talk over any difficulties with those with whom he happened to be working, and with others whose work happened to interest him. Baeyer's custom was to work himself with comparatively few of those engaged in research in his laboratories, and he left to the *Privatdozenten* almost entirely the supervision of the *Doctorarbeiten*.

Unless something of real interest had happened, it was usual for those working with him to tell him at once that there was nothing to report, and, in this way, Baeyer frequently made the tour of the large laboratories so rapidly that he was back in his private laboratory soon after 11 o'clock, and the whole of the rest of the day was spent at his own work. His private laboratory—a large and very

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well-lit room—usually contained, besides one private assistant, some other researcher in whose work he was specially interested, and it was not unusual for such a student to remain in the private laboratory for weeks at a time. Such an experience was, of course, of the utmost value to those who were fortunate enough to enjoy the privilege; in such circumstances it was impossible not to be profoundly influenced by the skill, patience, and resource with which the experimental difficulties of so many intricate problems were gradually overcome. His equipment for research consisted almost entirely of test tubes and glass rods, and it rarely happened that he used anything larger than quite small beakers and flasks. Large wooden racks containing hundreds of test tubes were always at hand, and it used to be said that these test tubes, after the usual wash, were subjected to a further cleaning, first with alcohol, and then with distilled water. Baeyer always insisted that the occurrence of a chemical change can be more easily observed and its course more closely followed with small quantities of material and the aid of a test tube and glass rod than by the employment of a hundred grams of substance and large flasks of beakers. That this view was undoubtedly correct is demonstrated not only by the brilliant results which Baeyer himself achieved with such simple means, but even more conclusively by the fact that his pupils, if perhaps reluctantly at first, all ultimately adopted his method of work. There can be no doubt that the discovery and careful characterization of so many substances, and the publication of so much important work covering such a wide field, would not have been possible had not Baeyer early acquired the habit of working with small quantities of material.

Baeyer's immense power of work is shown by the fact that, until his eightieth birthday, he delivered his usual lectures on five mornings of each week and continued to experiment in his laboratory with his usual unflagging energy. Had the war not robbed him of his private assistant and laboratory staff, it is probable that he would have gone on even longer. He confided to one of his intimate friends that work in the laboratory gave him as much pleasure after 50 years' toil as at any time during his career, and to the last he took the greatest interest in any developments in the domain of natural science which were brought to his notice. It is well known that he viewed with disfavor and apprehension the growing domination of military power in Berlin and Prussia generally, and it was mainly, no doubt, for this reason that he refused to accept the invitation to Berlin on the death of Hofmann.

Adolf von Baeyer was born on October 31, 1835, in Berlin, and he spent his early life in the house (242 Friedrichstrasse) of his grandfather, which at that time was a center of the literary life of Berlin,

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and it thus came about that Baeyer was brought up in a literary atmosphere. He always referred to this early intimate contact with literature with pleasure, and considered that the love for literature which he acquired in those days was of great service to him throughout his later career. Baeyer's chief interest in these early days seems to have been for botany and in living things generally, and his first contact with chemistry was on his ninth birthday, when his father gave him a copy of Stockhardt's "Schule der Chemie."

In his "Erinnerungen aus meinem Leben," which he wrote for the celebrations organized in connection with his seventieth birthday, he tells us that he converted a passage in the house into a small laboratory, and there carried out the usual dangerous and unpleasant experiments associated with early youth. It was during this time that he made his first discovery, that of the double salt, $CuCo_3$, Na_2CO_3, H_2O. The activity of the small laboratory does not seem to have been altogether appreciated, and the poet, Paul Heyse, who was a frequent visitor at the house, had reason to protest:

Es stinkt in diesem Haus gar sehr
Das kommt vom Adolf Baeyer her.

When he entered the university Baeyer seems at first to have entirely forsaken his chemical experiments and to have devoted himself to physics and mathematics, but the interest in chemistry soon returned, and in 1856 he entered Bunsen's laboratory at Heidelberg. After studying the methods of analysis in this famous laboratory for a year, he came under the influence of Kekulé, whom he afterwards followed to Ghent, and whom he always considered was his real teacher.

Baeyer obtained the Ph. D. degree in 1858; his dissertation, "De arsenici cu, methylo conjunctionibus," presented and printed in Latin, was a difficult and important piece of accurate work, and a great achievement for so young an investigator, especially as it was commenced and carried out entirely on his own initiative. In the spring of 1860 Baeyer returned to Berlin and became *Privatdozent* at that university, but in the same year he was appointed teacher in organic chemistry in the Gewerbe Institut, an institution which later developed into the Berliner Technische Hochschule. The foundations of many of Baeyer's most important researches were laid during the next few years, for we find him publishing papers on the uric acid group, mellitic acid, isatin and indigo, the reduction of benzene carboxulic acids, acetylene derivatives, etc., subjects which later developed into the classical memoirs with which his name is so intimately associated. Among the distinguished workers who were attracted to Baeyer's laboratory during this time we find the names of Graebe, Liebermann, Nencki, and Victor Meyer, and it was in

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1866 (Annalen, cxl., 295) that the method of reduction by distillation with zinc dust was elaborated which enabled Graebe and Liebermann to demonstrate that alizarin is a derivative of anthracene, and thus to proceed with the synthesis of this important coloring matter.

The next stage in Baeyer's career began in 1872, when he was appointed professor of chemistry in Strasburg, and it was here that he numbered among his pupils Emil and Otto Fischer and H. Caro, and produced many papers, of which those dealing with the phthaleins are probably the most important. Baeyer stayed in Strasburg for three years, and then proceeded in 1875 to Munich, where he remained for 40 years, and it was in the Munich laboratories that most of his famous researches reached maturity.

It is impossible to mention even the titles of the long series of papers which appeared with such regularity during this long period and are so well known to every student of chemistry. Mention may, however, be made of his researches on the phthaleins, the reduction of the phthalic acids, the constitution of benzene, indigo, and its derivatives, and last, but not least, the researches on the polyacetylene derivatives, which are marvels of experimental skill and have perhaps never been sufficiently appreciated.

His later researches were concerned with the peroxides, the constitution of Caro's acid, and particularly with the constitution of the oxonium salts and of the colored derivatives of triphenylmethane, and his last research, published in 1911, together with Jean Piccard, was on the oxonium salts derived from dimethylpyrone (Annalen, ccclxxxiv, 208, 224).

(Extract by W. H. Perkin, Nature, vol. 100, No. 2506 (Nov. 8, 1917). p. 188.)

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REPORT OF THE NATIONAL RESEARCH COUNCIL.

The preliminary steps in the organization of the National Research Council, which were given in detail in the last annual report of the academy, may be briefly recapitulated here. In April, 1916, when the attack on the *Sussex* had greatly increased the tension of our relations with Germany, the academy voted to offer to the President its services in organizing the scientific resources of the United States in the interest of the national security and welfare. This offer was immediately accepted. The President expressed the desire that the academy should coordinate the scientific resources of the entire country, and secure the cooperation of all agencies, governmental, educational, and industrial, in which research facilities are available. He also emphasized the fact that the chief national advantage of such cooperation and coordination would come after the war, and that its most lasting effect would be seen in scientific and industrial progress.

The National Research Council, comprising the chiefs of the technical bureaus of the Army and Navy, the heads of Government bureaus engaged in scientific research, a group of investigators representing educational institutions and research foundations, and another group including representatives of industrial and engineering research, was accordingly constituted by the academy with the active cooperation of the leading national scientific and engineering societies. On July 24, 1916, President Wilson addressed a letter to the president of the national academy expressing his approval of a preliminary report regarding the National Research Council, and promising his cooperation and that of the various departments of the Government. Since that time he has continued to give his support to the work of the National Research Council, and has appointed various representatives of the Government to membership in the council.

On February 28, 1917, the Council of National Defense passed a resolution expressing its recognition of the fact that the National Research Council, at the request of the President, had organized the scientific resources of the country in the interest of national defense and national welfare, and requesting the research council to cooperate with it in matters pertaining to scientific research for national defense. As the result of this action the chairman of the council opened

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offices in the Munsey Building in March and entered into active cooperation with the Council of National Defense, which was then established in the same building.

Soon afterwards the research council was requested to act as the department of science and research of the Council of National Defense, in which capacity it has continued to serve for the organization of investigations on military and industrial problems and, in harmony with the expressed wish of the President, as a coordinating agency in the field of science and research.

A further extension of the duties of the research council occurred in July, through the acceptance of the request of the Chief Signal Officer, expressed in the following letter:

WAR DEPARTMENT,
OFFICE OF THE CHIEF SIGNAL OFFICER,
Washington, July 2, 1917.

Dr. GEORGE E. HALE,
Chairman National Research Council,
Munsey Building, Washington, D. C.

MY DEAR DR. HALE: In the Signal Corps questions involving the selection and organization of large numbers of scientific men and the solution of research problems are constantly arising. The National Research Council, organized at the request of the President and acting as a department of the Council of National Defense, in close cooperation with similar bodies abroad, has federated and coordinated the scientific resources of the country and concentrated them upon the solution of military problems. It is accordingly the one agency in a position to meet the present needs of the Signal Corps.

I therefore request the research council to act as the advisory agent of the Signal Corps in the organization of its various scientific services and the solution of research problems. To this end I would suggest that Dr. Robert A. Millikan, vice chairman and executive officer of the research council, apply for a major's commission in the Officers Reserve Corps, for detail in charge of this work.

Very truly yours,

GEORGE O. SQUIER,
Brigadier General, C. S. O.

In accordance with this request Maj. (now Lieut. Col.) Millikan and Maj. Mendenhall were commissioned in the Signal Corps, and the work of the science and research division of the Signal Corps was immediately undertaken, as explained in a later section of this report.

Since that time the relations of the National Research Council with the various departments of the Government have rapidly developed. The military committee of the research council has been the chief factor in securing the necessary cooperation with the Army and Navy. This committee consists of the Chief of Operations of the Navy, the President of the Army War College, the Chiefs of Ordnance of the Army and Navy, the Chief Signal Officer of the Army.

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the Chief Naval Constructor, the Surgeon General of the Army, the Engineer in Chief of the Navy, the Chief of Engineers of the Army, the Director of Naval Intelligence, and the Chief of the Military Intelligence Section, together with the Chief of the Weather Bureau, the Chief of the Bureau of Chemistry, the Director of the Bureau of Mines, the Director of the Geological Survey, Mr. Howard E. Coffin of the advisory commission of the Council of National Defense, the Director of the Bureau of Standards (vice chairman), and the Secretary of the Smithsonian Institution (chairman).

RESEARCH INFORMATION COMMITTEE.

One of the most valuable results of the cooperation effected through the military committee is the organization of the research information committee, with offices in Washington, London, and Paris. The importance of this step, which should have direct influence upon international cooperation in scientific research, especially if the position of scientific attachés of our embassies abroad can be maintained after the war, is such as to warrant the following detailed statement regarding the organization and work of the research information committee:

1. By joint action the Secretaries of War and Navy, with the approval of the Council of National Defense, have authorized and approved the organization, through the National Research Council, of a research information committee in Washington, with branch committees in Paris and London, which are intended to work in close cooperation with the offices of the Military and Naval Intelligence, and whose function shall be the securing, classifying, and disseminating of scientific, technical, and industrial research information, especially relating to war problems, and the interchange of such information between the allies in Europe and the United States.

2. In Washington the committee consists of, first, a civilian member representing the National Research Council; second, the Chief, Military Intelligence Section; and, third, the Director of Naval Intelligence. Similar committees are being organized in Paris and London.

3. The initial organization of the committee in Paris is:

(*a*) The scientific attaché, representing the research information committee, Dr. W. F. Durand, attaché;

(*b*) The military attaché or an officer deputed to act for him;

(*c*) The naval attaché or an officer deputed to act for him.

4. The initial organization of the committee in London is

(*a*) The scientific attaché, representing the research information committee, Dr. H. A. Bumstead, attaché;

(*b*) The military attaché or an officer deputed to act for him;

(*c*) The naval attaché or an officer deputed to act for him.

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5. The chief functions of the foreign committees thus organized are intended to be as follows:

(*a*) The development of contact with all important research laboratories or agencies, governmental or private; the compilation of problems and subjects under investigation; and the collection and compilation of the results obtained.

(*b*) The classification, organization, and preparation of such information for transmission to the research information committee in Washington.

(*c*) The maintenance of continuous contact with the work of the offices of military and naval attachés, in order that all duplication of work or crossing of effort may be avoided, with the consequent waste of time and energy and the confusion resulting from crossed or duplicated effort.

(*d*) To serve as an immediate auxiliary to the offices of the military and naval attachés in the collection, analysis, and compilation of scientific, technical, and industrial research information.

(*e*) To serve as an agency at the immediate service of the commander in chief of the military and naval forces in Europe for the collection and analysis of scientific and technical research information and as an auxiliary to such direct military and naval agencies as may be in use for the purpose.

(*f*) To serve as centers of distribution to the American Expeditionary Forces in France and to the American naval forces in European waters of scientific and technical research information originating in the United States and transmitted through the research information committee in Washington.

(*g*) To serve as centers of distribution to our allies in Europe of scientific, technical, and industrial research information originating in the United States and transmitted through the research information committee in Washington.

(*h*) The maintenance of the necessary contact between the offices in Paris and London in order that provision may be made for the direct and prompt interchange of important scientific and technical information.

(*i*) To aid research workers or collectors of scientific, technical, and industrial information from the United States when properly accredited from the research information committee in Washington, in best achieving their several and particular purposes.

An appropriation of $38,400 has been made by the Council of National Defense to cover the expenses of the research information committee for the current year.

The natural development of the work of the research information committee will lead to the concentration in the office of the National

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Research Council, where the Washington headquarters of the committee is established, of all available information regarding research problems under investigation both in the United States and abroad. At the same time a service is being developed for the purpose of bringing properly accredited inquirers into touch with existing sources of scientific, technical, and engineering information in the United States. A central office from which inquirers may be directed to Government bureaus and other places where much information of this character is already available has long been needed, and it is probable that the services of the research information committee, once well organized, will be in increasing demand.

In this same field of supplying information on scientific, technical, and engineering subjects, the work of the research council has already been developed in several different directions. For example, a subcommittee of the geology committee, consisting of one geologist and one highway engineer from each of 19 States extending from Maine to Texas, has collected a very large body of information regarding materials for rapid highway construction along the coast. The elaborate report of this committee, bound in seven volumes, with three atlases, has already been of considerable service, not merely from the standpoint of those interested in highway construction for possible military purposes, but also to the Shipping Board in connection with the problem of building concrete ships, for which the stone quarries described in the report are often adapted. In another field the work of the botanical raw products committee has supplied extensive data relating to raw products required by industries, especially in cases where imports have been affected by the war. In still another field the research council has been called upon to cooperate with the War College in supplying information relating to topographical, geographical, and related subjects. Without mentioning other cases in which the aid of the research council has been sought for the purpose of supplying technical information, it is clear that this function of its work, not only during the war but after its conclusion, is likely to undergo extensive development. Problems are constantly arising in scientific research and in the industries which have been already solved, though the solutions are buried in the extensive technical literature so effectually as to render them practically inaccessible, even to those having large libraries. In Germany this difficulty has been met by establishing similar centers of information regarding scientific and technical questions, through which the desired advice and assistance can be obtained.

ACTIVITIES OF COMMITTEES.

The chief activities during the past year of the various committees of the research council may be briefly stated as follows:

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Advisory committee on toxicity of preserved foods (J. J. Abel, chairman): Appointed to act in conjunction with Dr. Milton J. Rosenau, of the Harvard Medical School, who has undertaken an exhaustive study of the toxicity of preserved foods for the American Canners Association.

Aeronautics committee (W. F. Durand, chairman): The executive committee of the national advisory committee for aeronautics serves also as the aeronautics committee of the National Research Council, dealing with a great variety of aeronautical problems.

Agriculture committee (Raymond Pearl, chairman; Karl F. Kellerman, secretary): This committee, with the approval of the Secretary of Agriculture, is acting as the medium for arranging for cooperation, and as a clearing house for bringing together the men who are working on similar agricultural problems, but who have been in ignorance of the special phases that other investigators are studying. The problems selected for immediate consideration cover a wide range, including the systematic correlation of work on the conservation of breeding stock, the development of special experiments upon the economic use of protein in animal food, and the significance of proteins of different kinds and in different quantities.

Anatomy committee (H. H. Donaldson, chairman): Formed for the promotion of research in anatomy; at present acting in cooperation with the authropology committee on war problems.

Anthropology committee (W. H. Holmes, chairman; Charles B. Davenport, vice chairman; Ales Hrdlicka, secretary): Through the action of this committee, which will untimately devote its attention to research in anthropology, the minimum height requirement for the American Army was rendered from 5 feet 4 inches to 5 feet 1 inch (5 feet was recommended by the committee), thus obviating the discrimination against the taller native American which otherwise would have resulted from the effect of immigration of shorter European peoples. The committee has also dealt with other physical and hygienic requirements of recruits, the standardization of measurements, the collection of data and materials for scientific research, and the provision of information required by the Government on anthropological subjects.

Astronomy committee (E. C. Pickering, chairman; Henry Norris Russell, vice chairman): The first report of this committee on the larger research problems of astronomy has been published in the Proceedings of the National Academy of Sciences. Members of the committee have also made valuable suggestions regarding war problems and are taking part in their solution.

Botany committee (J. M. Coulter, chairman): The prime object of this committee is to promote research in botany. During the period of the war its members are devoting their attention to such

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research problems as the following: Dehydration of fruits and vegetables, sources of rubber, improvement of sugar beets, disease-resistant cereals, drought-resistant cereals, cultivation of native drug plants, substitutes for cotton in the manufacture of explosives, the food reserves in certain plants.

Botanical raw products committee (E. M. East, chairman): This special committee is collecting data for a botanical raw-products clearing house, to aid manufacturers needing raw products of a botanical nature, such as gums, oils, resins, fibers, wood, etc., to find either new geographical sources or new specific sources.

National census of research (S. W. Stratton, chairman): This committee has prepared an elaborate census of the research men and facilities of those institutions in the United States having important research departments. The institutions from which data have been obtained are included in the following classes: Government, State, and city bureaus, educational institutions, research foundations, industrial establishments, and commercial testing laboratories.

Chemistry committee (M. T. Bogert, chairman): The chemistry committee, through its various subcommittees, has worked in close touch with various bureaus of the Army and Navy and with the War Industries Board and other agencies of the Council of National Defense; it has aided in the solution of many problems directly or indirectly connected with the prosecution of the war.

Engineering committee (Gano Dunn, chairman; W. F. Durand, vice chairman, in charge of Washington office): The work of this committee, which has the active support of the great national engineering societies, is at present concentrated upon war problems such as the development of devices for the protection of ships from submarines, of protective body armor, and of airplanes and airplane engines. In the future, however, it will deal with all forms of research in engineering.

Foreign service committee (Joseph S. Ames, chairman): This committee made a trip to France and England soon after the outbreak of the war and obtained much important information on military and industrial questions from the French and British Governments and from men of science engaged in the solution of war problems. In return an allied French, British, and Italian scientific mission came to this country, the members of which have worked in active cooperation with the National Research Council and have supplied American officials with additional information concerning instruments and research methods in warfare.

Committee on gases used in warfare (Van. H. Manning, chairman): This special committee, which was organized by the military committee with the cooperation of various Government departments,

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inaugurated extensive research work on the problems of gas warfare, which is being continued under the direction of the Bureau of Mines.

Geography committee (W. M. Davis, chairman): Suspending for the present its plans for the promotion of geographical research, this committee has devoted its chief attention to special maps for military purposes (in cooperation with the Geological Survey), instructions for the use of topographic maps, handbooks on military areas, and physiographic features of the United States.

Geology committee (J. M. Clarke, chairman): The geology committee has issued a booklet stating briefly a plan of the service which a trained geologist could render in war operations and for the national defense. Subcommittees have been organized with the following scope: Camp sites, trenches and water supply, roads and road materials, and measurement of earth vibrations. The subcommittee on roads and road materials, of which the late Dr. W. B. Clark was the very efficient chairman, is engaged in the examination of every location of rock material suitable for quick highway and railway construction along the Atlantic and Gulf coasts. Large-scale maps have been prepared on which are plotted in detail all supplies of such materials, including commercial quarries, natural ledges, accumulations of field stone, stone walls, sand and gravel banks, all located with reference to transportation facilities. Plans are being made for similar work along the Mexican boundary and the Pacific coast.

Committee on industrial research (J. J. Carty, chairman): The purpose of this committee (which has now become the section on industrial research of the administrative division of the research council) is to promote a wider appreciation of the importance of industrial research on the part of the industrial organization, both large and small, that have not yet experienced its benefits. Important steps have already been taken which promise to accomplish the purpose in view.

Mathematics committee (E. H. Moore, chairman): The purpose of this committee is to advance research in all branches of pure and applied mathematics. During the period of the war the committee is encouraging mathematicians to undertake the solution of problems developed by military needs.

Committee on medicine and hygiene (Victor C. Vaughan, chairman: This committee, now incorporated in the new medical division of the council, has dealt with many medical research problems relating to the war. The military work already organized includes the preparation of antitoxins and serums for diphtheria, tetanus, pneumonia, dysentery, and meningitis; researches on an intradermal method of vaccinating for smallpox; polyvalent vaccines for typhoid fever; sterilization of drinking water. infected wounds; shock,

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fatigue; occupational diseases, with special reference to munition workers; protection of the ear from high explosives; and instruction of Army and Navy surgeons in the Carrel method of antiseptic surgery. Several subcommittees have been appointed to deal with special subjects, notably among which may be mentioned a subcommittee on psychiatry, which has been authorized to establish abroad a laboratory for the study of shell shock.

Military committee (C. D. Walcott, chairman; S. W. Stratton, vice chairman): The organization of this important committee has already been described. Through the assistance of its members a large number of military research problems have been formulated for investigation by various branches of the research council. As a means of securing cooperation between various bureaus of the Army and Navy the committee is of special value.

Committee on navigation and nautical instruments (L. A. Bauer, chairman): This committee, which was appointed at the request of the general munitions board, is cooperating with the Emergency Fleet Corporation in the preparation of specifications for ship watches, to take the place of chronometers whenever necessary; sextants, compasses, aneroid barometers, thermometers, hydrometers, marine glasses, and other nautical equipment required for the emergency fleet.

Optical glass committee (R. A. Millikan, chairman): The problem of securing the necessary supply of optical glass for military and other purposes has been attacked by this committee, working in cooperation with the general munitions board. The work in progress, through the cooperation of the Bureau of Standards, the geophysical laboratory of the Carnegie Institution, and several industrial corporations has resulted in meeting the pressing need for optical glass for military purposes.

Patent office committee (L. H. Baekeland, acting chairman): This committee was appointed at the request of the Commissioner of Patents, with the approval of the Secretary of the Interior, to investigate the procedure of the Patent Office.

Physics committee (R. A. Millikan, chairman; C. E. Mendenhall, vice chairman): The physics committee, which has worked in close touch with various bureaus of the Army and Navy, has hitherto devoted its attention exclusively to military problems, though it will ultimately promote physical research for scientific and industrial purposes. In cooperation with the French scientific mission, it has organized conferences of physicists on certain military problems and initiated many investigations for their solution.

Physiology committee (W. B. Cannon, chairman; W. H. Howell, vice chairman): This committee, which has worked in cooperation with the committee on medicine and hygiene, has organized a large

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number of investigations on physiological problems developed by the war. It will subsequently deal with physiological research in its broadest aspects.

Psychology committee (Robert M. Yerkes, chairman): The psychology committee has made extensive tests on methods for eliminating mental defectives and nervous types from the Army, the selection of recruits especially fitted for aviation and other difficult tasks, the development of apparatus for testing the skill of naval gunners, and other military problems. The work of the committee has proved so effective that it has led to the organization of a psychology division of the Surgeon General's Office, under the charge of Maj. Yerkes, which will apply psychological tests to all new recruits of the Army.

Committee on research in educational institutions (R. H. Chittenden, chairman): Through the action of this committee (which has now become a section of the administrative division of the council), 72 universities and colleges have established research committees to cooperate with the National Research Council. As a rule, these committees are composed of representatives of the board of trustees of the institution, of the faculty, and in some cases of the alumni. The purpose of these committees is to promote scientific research in educational institutions and cooperation with local industries in the development and application of research methods. The important steps already taken by some of these committees to improve conditions for research promise to be of great significance if generally adopted by educational institutions.

Submarine committee (Robert A. Millikan, chairman): This committee has been actively engaged, in cooperation with the Navy, in the solution of problems connected with submarine warfare.

Zoology committee (Edwin G. Conklin, chairman): This committee, appointed for the promotion of research in zoology, is now giving its attention to certain important problems developed by the war.

FINANCIAL SUPPORT.

Rapid progress was hindered for several months by the fact that the membership of the committees was widely scattered, while the very limited funds at the disposal of the council prohibited any considerable concentration of its work in Washington. Under such circumstances the results obtained by the various committees during this preliminary period may be regarded in most cases as satisfactory. It was recognized, however, that as soon as conditions might permit, an improved organization, concentrating the work in Washington in immediate contact with the various departments of the Government and securing the necessary coordination of the work of committees

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dealing with closely related subjects, would be essential. The realization of such a plan, however, necessarily depended upon the financial position of the council.

The appended statement indicates in detail the present resources of the council, including also those of the Science and Research Division of the Signal Corps, since the work of this division is carried on in such intimate relationship with other activities of the council that the two could not be separated without serious loss of efficiency. It will suffice at this point, therefore, to speak in general terms of the successive steps in the development of our financial resources. At the outset we were fortunate enough to secure the cooperation and support of the Engineering Foundation, which offered its funds, supplemented by special gifts from Mr. Ambrose Swasey and Mr. Edward D. Adams, to assist in meeting the needs of the research council, and provided it with an office in New York, together with the services of its secretary. Subsequently, Mr. Cleveland H. Dodge and Mr. Martin A. Ryerson contributed toward the support of the council, and special gifts to the chemistry, geology, and psychology committees did much to facilitate their work. The chief difficulties of the formative period were overcome, however, through a grant of $50,000 to the National Research Council, made payable through the president of the Carnegie Institution of Washington. In physics, particularly, the action of the Chief Signal Officer provided the means of developing the large number of physical devices required for the use of the Signal Corps, and also of equal value for other branches of the service. The connection of the council with the Army and Navy, through its military committee and also through the appointment of some of its members to military positions, has been of great value in establishing cross connections between bureaus interested in similar research problems, and in rendering available to both arms of the service devices developed through any special agency.

Thus the period marked by serious limitation of funds, felt in all phases of the council's work, is giving place to a new period, in which the work is progressing much more effectively. Like other bodies working during the first months of the war with the Council of National Defense, the research council provided its own funds and paid its own expenses. The nature of our work could not be expected to make a strong appeal until sufficient success had been attained to demonstrate its thoroughly practical value. Thus while special grants were made by both the War and Navy Departments to cover the expenses of various investigations organized by the research council, no general appropriation was obtained until January 7, 1918, when the President authorized a grant of $29,250 from his special fund, through the Council of National Defense, for the rental of the

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building at 1023 Sixteenth Street, now occupied by the research council, and for other miscellaneous expenses. The second important appropriation received through the Council of National Defense was the sum of $38,400, already mentioned in describing the work of the research information committee.

These cases illustrate how the work of the National Research Council has gradually gained the recognition and support of the Government. But in many instances grants from private funds are not only desirable, but essential to success. In certain bureaus of the Government ample funds are available for research. In other bureaus little or nothing has been provided for such purposes. But even when research funds are available, they can not ordinarily be appropriated until some specific device reaches a stage where its further development is clearly advisable. Thus the expenses of the international conference for the discussion of submarine problems, organized in June, 1917, were borne by the research council, and the necessary traveling expenses of several of the physicists who subsequently took part in the researches conducted in cooperation with the Navy were also met from our funds. As for the cost of these researches, this was borne in part by universities and other organizations, in part by the research council, and in part by the Navy Department, which has recently developed special laboratories and other facilities for this purpose, and provided large funds for its prosecution.

WAR ORGANIZATION.

As soon as the improved financial position of the council permitted, the following war organization of the council was undertaken, combining the work of its committees in various divisions, and concentrating its activities in Washington:

OFFICERS.

GEORGE E. HALE.....*Chairman*
CHARLES D. WALCOTT.....*First Vice Chairman*
GANO DUNN.....*Second Vice Chairman*
R. A. MILLIKAN.....*Third Vice Chairman*
JOHN JOHNSTON.....*Executive Secretary*
WHITMAN CROSS.....*Treasurer*
WALTER M. GILBERT.....*Assistant Secretary*
ALFRED D. FLINN.....*Assistant Secretary*

EXECUTIVE BOARD.

JOHN J. CARTY.....*Chairman*

Officers, chairmen and vice chairmen of divisions; the chairmen of sections of the administrative division; and 10 members at large.

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ADMINISTRATIVE DIVISION.

ARTHUR A. NOYES, *Chairman.*

Sections: FOREIGN RELATIONS, GEORGE E. HALE, *Chairman.*
GOVERNMENTAL RELATIONS, ———, *Chairman.*
STATE COUNCIL RELATIONS, JOHN C. MERRIAM, *Chairman.*
INDUSTRIAL RESEARCH, JOHN JOHNSTON, *Chairman.*
RESEARCH IN EDUCATIONAL INSTITUTIONS, JOHN C. MERRIAM, *Chairman.*
RESEARCH INFORMATION, ———, *Chairman.*

Committees included in the Administration Division:

1. RESEARCH INFORMATION COMMITTEE—
   Washington: S. W. STRATTON, *Chairman;* Chief of Naval Intelligence Service; Chief of Army Intelligence Service; GRAHAM EDGAR, *Technical Assistant;* W. M. GILBERT, *Secretary.*
   Paris: W. F. DURAND, Representing National Research Council; Representative of Naval Intelligence Service; Representative of Army Intelligence Service; K. T. COMPTON, *Technical Assistant;* Lieut. TOD FORD, *Assistant.*
   London: H. A. BUMSTEAD, Representing National Research Council; Representative of Naval Intelligence Service; Representative of Army Intelligence Service; S. W. FARNSWORTH, *Technical Assistant.*
2. COMMITTEE ON CENSUS OF RESEARCH, S. W. STRATTON, *Chairman.*
3. PATENT OFFICE COMMITTEE, L. H. BAEKELAND, *Acting Chairman.*

MILITARY DIVISION.

CHARLES D. WALCOTT, *Chairman* (Secretary, Smithsonian Institution).
S. W. STRATTON, *Vice Chairman* (Director, United States Bureau of Standards).
CARL L. ALSBERG, Chief, Bureau of Chemistry, United States Department of Agriculture.
Admiral WILLIAM S. BENSON, Chief of Naval Operations, United States Navy.
Maj. Gen. WILLIAM S. BLACK, Chief of Engineers, United States Army.
HOWARD E. COFFIN, member of advisory commission, Council of National Defense.
Maj. Gen. WILLIAM CROZIER, Chief of Ordnance, United States Army.
Rear Admiral RALPH EARLE, Chief, Bureau of Ordnance, United States Navy.
WALTER S. GIFFORD, Director, Council of National Defense.
Maj. Gen. WILLIAM C. GORGAS, Surgeon General, United States Army.
Rear Admiral ROBERT S. GRIFFIN, Engineer in Chief, United States Navy.
Brig. Gen. P. D. LOCKRIDGE, President, Army War College, United States Army.
VAN H. MANNING, Director, United States Bureau of Mines.
CHARLES F. MARVIN, Chief, United States Weather Bureau.
GEORGE O. SMITH, Director, United States Geological Survey.
Maj. Gen. GEORGE O. SQUIER, Chief Signal Officer, United States Army.
Rear Admiral DAVID W. TAYLOR, Chief Constructor, United States Navy.
Col. RALPH H. VAN DEMAN, Chief of Military Intelligence Section, United States Army.
Capt. ROGER WELLES, Director of Naval Intelligence, United States Navy.

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DIVISION OF ENGINEERING.

HENRY M. HOWE, *Chairman.*

SECTION OF AERONAUTICS, WILLIAM F. DURAND, *Chairman.*
SECTION OF METALLURGY, HENRY M. HOWE, *Chairman.*
SECTION OF MECHANICAL ENGINEERING, S. L. G. KNOX, *Chairman.*
Other sections are in process of organization.
Committees included in the engineering division: 1. Engineering committee, GANO DUNN, *Chairman.* (*a*) Subcommittee on protective body armor, BASHFORD DEAN, *Chairman.*

DIVISION OF PHYSICS, MATHEMATICS, ASTRONOMY, AND GEOPHYSICS.

(SEE P. —, SCIENCE AND RESEARCH DIVISION, UNITED STATES SIGNAL CORPS.)

R. A. MILLIKAN, *Chairman.*
C. E. MENDENHALL, *Vice Chairman.*

Committees included in physics division:
1. PHYSICS COMMITTEE, R. A. MILLIKAN, *Chairman*—
Subcommittees: SUBMARINE INVESTIGATIONS (nine groups).
WIRELESS.
LOCATION OF INVISIBLE AIRCRAFT.
LOCATION OF MINING AND TUNNELING OPERATIONS.
MUZZLE VELOCITY OF PROJECTILES.
NAVAL RANGE FINDERS.
RANGE FINDERS FOR ANTIAIRCRAFT SERVICE.
STATIC CHARGES ON AIRSHIPS.
SUBMARINE MINES.
USE OF HIGH PRESSURE IN MANUFACTURE OF GUNS.
VISIBILITY.
MONOCULARS AND BINOCULARS.
CAMOUFLAGE and others.
2. MATHEMATICS COMMITTEE, E. H. MOORE, *Chairman.*
3. ASTRONOMY COMMITTEE, E. C. PICKERING, *Chairman;* H. N. RUSSELL, *Vice Chairman.*
4. COMMITTEE ON OPTICAL GLASS, R. A. MILLIKAN, *Chairman.*
5. COMMITTEE ON NAVIGATION AND NAUTICAL INSTRUMENTS, L. A. BAUER, *Chairman.*

DIVISION OF CHEMISTRY AND CHEMICAL TECHNOLOGY.

JOHN JOHNSTON, *Chairman.*
W. H. WALKER, *Vice Chairman.*

Committees included in the chemistry division:
1. CHEMISTRY COMMITTEE, JOHN JOHNSTON, *Chairman*—
Subcommittees: ANALYTICAL CHEMISTRY, WILLIAM F. HILLEBRAND, *Chairman.*
CHEMICAL APPARATUS, ARTHUR H. THOMAS, *Chairman.*
BIOCHEMISTRY, FRANK P. UNDERHILL, *Chairman.*

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CARBOHYDRATE CHEMISTRY, CLAUDE S. HUDSON, *Chairman.*

CHEMISTRY OF CELLULOSE AND PAPER, ARTHUR D. LITTLE, *Chairman.*

CHEMISTRY OF CEMENTS AND RELATED BUILDING MATERIALS, PREVOST HUBBARD, *Chairman.*

CHEMISTRY OF CERAMICS, EDWARD W. WASHBURN, *Chairman.*

CHEMISTRY OF DYESTUFFS AND TEXTILES, JOSEPH M. MATHEWS, *Chairman.*

ELECTROCHEMISTRY, WILDER D. BANCROFT, *Chairman.*

CHEMISTRY OF EXPLOSIVES, ARTHUR M. COMEY, *Chairman.*

CHEMISTRY OF FATS, FATTY OILS, AND SOAPS, MARTIN H. ITTNER, *Chairman;* DAVID WESSON, *Vice Chairman.*

CHEMISTRY OF FERMENTATION AND FERMENTATION PRODUCTS, JOHN H. LONG, *Chairman.*

FOOD CHEMISTRY, CARL L. ALSBERG, *Chairman.*

FOREST PRODUCTS, JOHN E. TEEPLE, *Chairman.*

CHEMISTRY OF FUELS, RAYMOND F. BACON, *Chairman.*

GASES USED IN WARFARE, GEORGE A. BURRELL, *Chairman.*

CHEMISTRY OF GLASS, ARTHUR L. DAY, *Chairman.*

CHEMISTRY OF GLUE AND OTHER COLLOIDS, JEROME ALEXANDER, *Chairman.*

INORGANIC CHEMISTRY, WILLIAM C. BRAY, *Chairman.*

CHEMISTRY OF LEATHER AND TANNING, ALLEN ROGERS, *Chairman.*

METALLURGICAL CHEMISTRY, JOSEPH W. RICHARDS, *Chairman.*

MINERALOGICAL AND GEOLOGICAL CHEMISTRY, FRANK W. CLARKE, *Chairman.*

NITRATES AND AMMONIA, ARTHUR A. NOYES, *Chairman.*

ORGANIC CHEMISTRY, WILLIAM A. NOYES, *Chairman.*

CHEMISTRY OF PAINTS, VARNISHES, AND RESINS, HENRY A. GARDNER, *Chairman.*

PHARMACEUTICAL CHEMISTRY, FREDERICK B. POWER, *Chairman.*

PHYSICAL CHEMISTRY, ARTHUR B. LAMB, *Chairman.*

PLATINUM AND RELATED METALS, JAMES LEWIS HOWE, *Chairman.*

PRIMERS, RICHARD C. TOLMAN, *Chairman.*

CHEMISTRY OF RUBBER AND ALLIED SUBSTANCES, DAVID SPENCE, *Chairman.*

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CHEMISTRY OF SOILS AND FERTILIZERS, HOMER J. WHEELER, *Chairman.*

CHEMISTRY OF SYNTHETIC DRUGS, JULIUS STIEGLITZ, *Chairman.*

TEXTILE COATINGS, EDWARD C. WORDEN, *Chairman.*

CHEMICAL ENGINEERING, CHARLES F. MCKENNA, *Chairman.*

2. COMMITTEE ON GASES USED IN WARFARE, VAN. H. MANNING, *Chairman.*

DIVISION OF GEOLOGY AND GEOGRAPHY.

JOHN C. MERRIAM, *Chairman.*
WHITMAN CROSS, *Vice Chairman.*

Committees included in division of geology and geography:

1. GEOLOGY COMMITTEE, JOHN M. CLARKE, *Chairman*—
   PACIFIC COAST SUBCOMMITTEE ON GEOLOGY, J. C. MERRIAM, *Chairman.*
   Subcommittees: MATERIALS FOR RAPID HIGHWAY CONSTRUCTION, EDWARD B. MATHEWS, *Chairman.*
   WATER SUPPLY FOR CAMPS, R. A. F. PENROSE, *Chairman.*
   MEASUREMENTS OF EARTH VIBRATIONS, J. B. WOODWORTH, *Chairman.*
   GEOLOGY OF CANTONMENTS AND TOPOGRAPHICAL INSTRUCTION IN TRAINING CAMPS, FRANK W. DE WOLF, *Chairman.*
2. GEOGRAPHY COMMITTEE, W. M. DAVIS, *Chairman.*

DIVISION OF MEDICINE AND RELATED SCIENCES.

R. M. PEARCE, *Chairman.*
ROBERT M. YERKES, *Vice Chairman.*

Committees included in medical division:

1. ANATOMY COMMITTEE, H. H. DONALDSON, *Chairman.*
2. PHYSIOLOGY COMMITTEE, W. B. CANNON, *Chairman;* W. H. HOWELL, *Vice Chairman*—
   SUBCOMMITTEE FOR INVESTIGATIONS ON THE PHYSIOLOGY OF SHOCK, W. B. CANNON, *Chairman.*
   Subcommittees: CONTROL OF HEMORRHAGE, W. H. HOWELL, *Chairman.*
   SOLUTIONS ADAPTED FOR TRANSFUSION AFTER HEMORRHAGE, L. J. HENDERSON, *Chairman.*
   MUSCULAR WORK AND FATIGUE, FREDERICK S. LEE, *Chairman.*
3. COMMITTEE ON MEDICINE AND HYGIENE, VICTOR C. VAUGHAN, *Chairman*—
   SUBCOMMITTEE ON PSYCHIATRY, STEWART PATON, *Chairman.*
4. PSYCHOLOGY COMMITTEE, ROBERT M. YERKES, *Chairman;* JOHN W. BAIRD, *Vice Chairman.*
   Subcommittees: METHODS FOR THE PSYCHOLOGICAL EXAMINATION OF RECRUITS, ROBERT M. YERKES, *Chairman.*
   TESTS OF SPECIAL SKILL, EDWARD L. THORNDIKE, *Chairman.*

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PROBLEMS OF AVIATION, INCLUDING THE EXAMINATION OF AVIATION RECRUITS, EDWARD L. THORNDIKE, *Secretary.*

INCAPACITY, REEDUCATION, AND VOCATIONAL TRAINING, SHEPHERD I. FRANZ, *Chairman.*

VISUAL PROBLEMS, RAYMOND DODGE, *Chairman.*

PROBLEMS OF MILITARY TRAINING AND DISCIPLINE, WILLIAM C. BAGLEY, *Chairman*

5. ANTHROPOLOGY COMMITTEE, CHARLES B. DAVENPORT, *Chairman;* ———, *Vice Chairman;* ALES HRDLICKA, *Secretary.*
6. COMMITTEE ON MEDICAL ZOOLOGY, WITH GROUPS REPRESENTING—
   (*a*) ENTOMOLOGY.
   (*b*) HELMINTHOLOGY.
   (*c*) PROTOZOOLOGY.
7. ADVISORY COMMITTEE ON TOXICITY OF PRESERVED FOODS, J. J. ABEL, *Chairman.*

DIVISION OF AGRICULTURE, BOTANY, FORESTRY, FISHERIES, AND ZOOLOGY.

VERNON L. KELLOGG, *Chairman.*

Committees included in division of agriculture and related subjects:

1. AGRICULTURE COMMITTEE, KARL F. KELLERMAN, *Secretary.*
2. BOTANY COMMITTEE, JOHN M. COULTER, *Chairman.*
3. BOTANICAL RAW-PRODUCTS COMMITTEE, E. M. EAST, *Chairman.*
4. ZOOLOGY COMMITTEE, C. E. MCCLUNG, *Representative.*

FUNCTIONS OF DIVISIONS.

It is impossible within the limits of this report to give a detailed account of the work of the various divisions and of the committees grouped under them. Reports of the meetings of the executive board of the council have been published in the Proceedings of the National Academy of Sciences, where many of the committees have also published reports. In order to give an intelligent idea of the present status and activities of the council, however, it will be necessary to speak briefly of the plan of organization and of the work of the various divisions.

EXECUTIVE BOARD.

The executive board of the war organization takes the place of the former executive committee of the council. It is constituted of the chairmen and vice chairmen of the various divisions, the chairmen of the sections of the administrative division, together with several members at large. The executive board meets monthly and transacts the general business of the council. In order to secure prompt action when needed, however, a smaller committee has been authorized to act when necessary, subject to the approval of the executive board.

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ADMINISTRATIVE DIVISION.

The administrative division consists of five sections dealing with the various relations of the council, and also includes the work of the research information committee. The section which is to be devoted to the promotion of industrial research is at present under organization. This is certain to prove one of the most valuable branches of the council's work, as it will be called upon to assist in securing the widest possible appreciation of the necessity of introducing scientific research on a large scale into the industries. The British advisory council for scientific and industrial research has been especially active in this field, and has already secured results which will greatly strengthen some of the larger industries of the British Empire.

At the request of the Commissioner of Patents, and with the approval of the Secretary of the Interior, the National Research Council has organized a committee to investigate and report upon the work of the Patent Office in the hope of finding means of improving the present procedure. The work of this committee will be done in connection with the other activities of the administrative division.

The establishment of research committees in connection with several of the State councils of defense, and the necessity of securing suitable cooperation between these committees and the National Research Council, has led to the formation of an important section of the administrative division. The chairman of this division, who has had extensive experience as chairman of the research committee of the California State Council of Defense, prepared the following report, which has been adopted as expressing the attitude of the National Research Council toward the work of State research committees:

"It is the opinion of your committee that the greater part of the problem work of the National Research Council can be handled most satisfactorily through the special committees or divisions established for research in specific fields of investigation. To a limited extent phases of these investigations of problems may be turned over to adequately organized and supported research groups in different parts of the country, some of these groups representing educational or research institutions and others being organized under the auspices of State governments or State councils of defense.

"As numerous important problems of research relate to the development of natural resources, industries, consideration of health conditions, and other problems of a local nature, it seems desirable in many cases to have an organization of research interests related to the State, and if possible supported by it. Such organizations might,

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under existing conditions, be best cared for as committees under the State councils of defense.

"It is desirable to have the National Research Council so related to the State research scientific committees that the results of their investigations may become quickly available to the central office of the council, and that the needs of the council for work of a local character may be met by the State committees.

"Your committee respectfully suggests the following definition of function, organization, and relations of State research committees:

Function of State Research Committees.—"Problems involving local needs in development of natural resources, local industries, health conditions, or any matters to which science may lend its aid.

"Problems involving local materials, industries, laboratories, or talent, development or use of which would contribute to the good of the Nation as a whole or in part regardless of questions of needs of the State in which the investigation originates.

Organization of State Committees.—"In intial organization the State committee should be small but widely representative of fields of research. Additions to membership should be made as the development of actual research progresses. The committees should, at the outset, include members of State boards covering work in which scientific research plays an important part and representatives of scientific organizations or institutions at which significant research is in progress, especially institutions in which research committees are organized.

"State research committees should at this time be organized as subdivisions of State councils of defense, where such councils exist.

"Financial support of State committees should come from State funds received by way of the State councils of defense, or from other special funds. It is in all cases desirable to have secretarial organization permitting full correspondence on all matters relating to the committee.

Relation of Research Council to State Committees.—"It is desirable to have the State research committees affiliated with the National Research Council; the results of work of these committees should be reported to the State council of defense and to the National Research Council by way of either or both of these bodies; results obtained by the State research committees should go to the Council of National Defense when needed."

The research council is already working in active cooperation with several State research committees, and information is being supplied to various State councils of defense which have asked for suggestions regarding research.

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The work of the committee on research in educational institutions has already been described. The functions of this committee will be extended and developed through the administrative division of the council.

MILITARY DIVISION.

The constitution of the former military committee of the council is explained above. In the war organization this committee becomes the military division of the council. Under it various extensions of the present work will be organized.

ENGINEERING DIVISION.

In the case of engineering, the council has been acting hitherto through its committees on engineering and aeronautics, both of which will be incorporated in the new division of engineering. The various sections of the engineering divisions are now under organization. One of the most important of these sections is that of metallurgy, the organization of which is nearly complete. The section of design of the science and research division of the United States Signal Corps will also work in close cooperation with the division of engineering and essentially as one of its sections. Other sections of the division are now in process of formation.

DIVISION OF PHYSICS.

The work of the committees of physics, mathematics, astronomy, optical glass, and navigation and nautical instruments is now concentrated in the division of physics and related sciences, which also comprises the work of the Science and Research Division of the United States Signal Corps. The character of the work conducted by this division of the Signal Corps is indicated by the following outline of its various activities:

Lieut. Col. R. A. Millikan, officer in charge of activities in Washington, D. C.

I. Aeronautics instrument section, Maj. C. E. Mendenhall.

(*a*) Expert testing of lenses, First Lieut. A. K. Chapman (laboratory, Kodak Park, Rochester, N. Y., in charge of Mr. F. M. Bishop).

(*b*) Specification, design, and development of photographic apparatus and methods of mounting cameras in airplanes, Capt. H. E. Ives.

(*c*) Computation and other development work in connection with airplane bombs and bomb sights, Prof. Wilmer A. Duff.

(*d*) Technical consultation in connection with development of oxygen apparatus, Dr. E. J. Eyster.

II. Signaling section, Pvt. A. J. Dempster. Development of new signaling devices.

III. Design section, Mr. S. L. G. Knox. A new type of airplane gun is being developed and designed with the aid of an appropriation from the Board of Ordnance and Fortifications.

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Activities abroad.—Second Lieut. Leonard B. Loeb, Signal Reserve Corps, A. S. Laboratoire de l'Intérieur, Paris; First Lieut. Tod Ford, jr., liaison officer, headquarters A. E. F.

IV. Meteorological section:

Activities abroad.—Maj. Edward H. Bowie, headquarters A. E. F. Officers and enlisted men have been ordered abroad for meteorological work in connection with American expeditionary force.

Activities in the United States.—Lieut. B. J. Sherry, United States Weather Bureau, Washington, D. C.

Meteorological stations have been opened at the following points in the United States: Fort Leavenworth, Kans., Pvt. Eckley Ellison; Langley Field, Va., Pvt. Allan E. Waterman; Camp Devens, Mass., Pvt. H. R. Grenrich; Fort Screven, Ga., Pvt. Roy J. Rogers; Fort Snelling, Minn., Pvt. P. E. Johnson.

The following aerological stations have been opened: Sandy Hook, N. J., Second Lieut. John W. Howard; Fort Omaha, Nebr., Pvt. William E. Bowen.

V. Other activities under science and research division in the United States:

Baltimore, Md., Johns Hopkins University, Maj. R. W. Wood. New methods of various kinds; devices for preventing airplanes catching fire, etc.

New London, Conn., signaling experiments in charge of Pvt. Arthur J. Dempster, care of Naval Experiment Station.

Langley Field, Va., Signal Corps research laboratory, Pvt. A. H. Nietz.

As for the other work of the division of physics and the related sciences, its nature is sufficiently illustrated by the list of subcommittees given in the plan of war organization.

DIVISION OF MEDICINE AND RELATED SCIENCES.

The division of medicine and the related sciences has been organized with special reference to military needs. The committees of the research council grouped under this division are those which are directly related to experimental medicine or to subjects also dealt with under the Surgeon General's office. The chief purposes of the division are:

1. To cooperate closely with the Surgeon General of the Army (through Col. Russell) and of the Navy (through Dr. Stitt) in determining urgent problems and to enlist the aid of civilian laboratories in the solution of these problems.

2. To assist the Surgeon Generals of the Army and Navy in procuring trained investigators to enter the respective services as contract surgeons to undertake special field investigations during short periods of time.

3. To send, if it is considered advisable, commissions or individuals abroad, to determine the urgent problems which should be taken up without loss of time in civilian laboratories in this country.

4. To invite, if it is considered necessary, commissions or individuals from foreign countries to this country to advise with the medical division of the National Research Council.

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5. To maintain correspondence with prominent medical investigators in the American Expeditionary Forces and in civilian laboratories in France, England, and Italy, and thus obtain reports of the important fields of research, the character of the work in progress, and the needs of the workers.

6. To establish relations with, and, if agreeable to them, to cooperate with research organizations abroad, as (*a*) British medical research committee, (*b*) the research society recently organized in France by medical officers of American, French, and British forces, and (*c*) the committee on medical research of the American Red Cross in France, etc.

7. To obtain reports of all medical research organizations in this country dealing with war problems and of individuals engaged in the investigation of war problems.

8. To maintain a bureau for the dissemination of up-to-date bibliographies of all forms of medical research bearing on war problems.

9. (*a*) To prepare lists of individuals and laboratories equipped and ready to undertake research at short notice. (*b*) To prepare lists of individuals who will hold themselves in readiness to work for shorter or longer periods on special or emergency problems or to augment existing laboratory staffs in a group of selected laboratories, such as the Rockefeller, Sprague, and Hooper Institutes and research departments of certain universities.

10. To hold conferences from time to time in Washington or other central city for discussion of important research problems and methods of attack.

11. To hold military medical meetings from time to time in the neighborhood of large cantonments for the discussion of medical problems by military and civilian physicians.

DIVISION OF CHEMISTRY AND CHEMICAL TECHNOLOGY.

The chemical work of the council has been reorganized and is now in the hands of a division of chemistry and chemical technology, the purpose of which is to secure effective cooperation in the investigation and solution of the many pressing problems involving chemistry and chemical engineering which have been raised by the war. These problems are so multifarious that they can not be readily summarized or tabulated, but the following general statements may serve to illustrate the work of the division. Its chief purposes are:

1. To ascertain the most urgent problems arising out of the various war activities of the Government, and to place these problems before men qualified to solve them.

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2. To enlist the support of the chemists and chemical technologists, and to keep as fully informed as possible about their training and qualifications so as to aid the Government in the selection of competent men in chemical work here or abroad.

3. To aid in the interchange of information with our allies; to keep in touch with all chemical research work now going on in this country and to keep informed upon the chemical equipment available at the various institutions and industrial plants where such work could be carried on.

4. To cooperate with manufacturers in an endeavor to utilize waste and by-products, to devise acceptable substitutes for raw materials which are scarce or urgently needed for other purposes, to promote the manufacture of wholly new substances (for example, for gas warfare), and to insure that the equipment in men and material may be used to the best advantage.

5. To point out the advisability of having new and up-to-date advanced textbooks and reference works in chemistry in English, and to work toward securing a better appreciation and a more intelligent support of chemistry on the part of the community.

6. To hold conferences in Washington or elsewhere for the discussion of important research problems, or of ways and means of making the work of the division more effective.

DIVISION OF GEOLOGY AND GEOGRAPHY.

The division of geology and geography has prepared a plan for utilizing the large amount of preparatory work which has been accomplished by the committees on geology and geography with a view to adapting the work of the division most directly to the problems of the war. It is hoped that closer touch with departments of the Government connected with war work will serve to increase the effectiveness of both committees.

The division is collating the data contained in replies to questionnaires sent out by Government bureaus and geological and techincal societies, in order to bring into one list the essential facts as to the geologists and geographers of the country with regard to the nature and conditions of service that can best be rendered by them in the war, and the researches they are conducting which bear on war problems.

The resources of the division have been especially placed at the disposal of the intelligence section of the War College for the assembling of any information which it may require.

DIVISION OF AGRICULTURE, BOTANY, ZOOLOGY, FORESTRY, AND FISHERIES.

The division of agriculture, botany, zoology, forestry, and fisheries is now in process of organization. Its functions will be analogous to

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those of the medical division, and it is hoped that it may secure the necessary coordination of researches in the field it occupies.

FUTURE OF THE NATIONAL RESEARCH COUNCIL.

The results already accomplished by the National Research Council and the increasing requests for its assistance seem to leave no doubt as to the need for a centralizing body of this character. A plan of permanent organization, adapted for the conditions existing after the war, is being carefully studied. The organization of the research council under the charter of the National Academy of Sciences is undoubtedly sound. It provides the necessary connection with the Government and eliminates all political influences from the appointment of its members. The inclusion of the heads of Government bureaus devoting special attention to research and the plan of securing their appointment by the President on the nomination of the National Academy provides for the first time a means of effecting necessary cooperation between these bureaus, which have developed to great proportions and have at their disposal large sums for scientific research. Other elements in the permanent scheme of organization must be such as to assure the close cooperation of all research agencies in the country and of the chief national scientific, technical, and engineering societies interested in research. The widespread cooperation already secured and the experience gained in connection with the war will afford a useful guide for the development of a sound and effective plan.

GEORGE E. HALE, *Chairman.*

STATEMENT OF CONTRIBUTIONS AND APPROPRIATIONS FOR THE WORK OF THE NATIONAL RESEARCH COUNCIL FROM SEPT. 1, 1916, TO MAR. 1, 1918, (18 MONTHS).

1. Cash donated to the council on account of general expenses of office, maintenance, and special investigations:		
A. Engineering Foundation:		
1. Services of secretary	$5,000.00	
2. Expenses of committees	510.00	
3. Office and traveling expenses	3,526.09	
		$9,036.09
B. George S. Isham		50.00
C. Martin A. Ryerson		1,000.00
D. Anonymous		100.00
E. Cleveland H. Dodge		5,000.00
F. Clarence H. Mackay, for expenses connected with work of subcommittee on protective body armor		1,000.00
G. Carnegie Corporation of New York		50,000.00
H. Rockefeller Foundation, for Division of Medicine and Related Sciences		50,000.00

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I. Special contributions for work of psychology committee		$4,100.00
J. Special contributions for work of chemistry committee		4,614.05
K. Special contributions for work of geology committee		800.00
		74,700.14
II. Governmental appropriations available for work under immediate direction of research council:		
A. President's emergency appropriation (available through the Council of National Defense):		
1. General office expenses of research council		29,250.00
B. Council of National Defense:		
1. Appropriation for agriculture committee	$3,000.00	
2. Appropriation for research information committee	38,400.00	
		41,400.00
C. War Department, Ordnance Bureau:		
1. Special appropriation for development of new type of gun by research council	15,000.00	
		15,000.00
		160,350.14
III. Governmental appropriation for work organized in connection with the national research council (estimated):		
A. United States Signal Corps, for work of Science and Research Division:		
1. Personnel	$45,000.00	
2. Equipment and supplies	65,000.00	
		110,000.00
		270,350.14

Many other appropriations have been made by Government bureaus, educational institutions, and private research laboratories for investigations which have been conducted more or less directly in cooperation with the research council. The total amount of such contributions for research work can not be closely estimated.

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ANNUAL REPORT OF THE TREASURER.

JANUARY 1 TO DECEMBER 31, 1917.

To the PRESIDENT OF THE NATIONAL ACADEMY OF SCIENCES:

I have the honor to submit the following report as treasurer, for the fiscal year January 1, to December 31, 1917. Some of the items of general interest will be mentioned before presenting details.

The volume of financial transactions, apart from investments, is indicated by the statement that the income of the academy from dues, interest on investments, subscriptions to the Proceedings, contributions to Proceedings fund, and the William Ellery Hale lectureship was $17,092.44, while the miscellaneous disbursements amounted to $9,567.65 and payments on grants from trust funds and for medals were $6,569.12.

The sum of investments held by the academy on December 31 was $248,623.50, yielding on that date at the rate of 5.01 per cent.

Changes in investments may be summarized as follows: Loans on real estate aggregating $15,000 were paid and loans amounting to $18,000 were renewed at increased rates of interest; bonds of the face value of $26,500 were purchased for $25,618.75.

In accordance with the action of the academy in November, 1916, the capital of the Marsh fund was increased to $18,500 through the addition to it of interest on the deferred payments of the bequest from Prof. O. C. Marsh, received in 1916, and by transfer of accumulated income. By the addition of further increments of $500 annually from income this fund will, on February 1, 1920, reach the total of $20,000 authorized by the academy.

A first payment of $2,500 was received from the executors of the estate of Mrs. Mary Anna Palmer Draper toward the total of $25,000 bequeathed to the academy by Mrs. Draper in 1915 to establish the Billings fund.

The sum of $1,068.52 was added to the Comstock fund from accumulated income on November 20, 1917, in accordance with the directions of the donor.

The sum of $6,487.20 was received toward defraying expenses of the National Research Council and $4,147.85 was expended for that purpose.

The consolidated investment fund reached a total of $176,745.50 by the addition during the year of the Murray and Billings funds and the increase of the Marsh fund.

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TRUST FUNDS OF THE ACADEMY.

The trust funds of the academy, the income of which is administered for specific purposes, are enumerated below. The capital of certain funds has been increased beyond the amount of the original gift or bequest, by the transfer of accumulated income, at the request of the donors or by action of the academy.

Bache fund: Bequest of Alexander Dallas Bache, a member of the academy, 1870. To aid researches in physical and natural sciences $56,000.00

Watson fund: Bequest of James C. Watson, a member of the academy, 1874. For the promotion of astronomical science through the award of the Watson gold medal and grants of money in aid of research 25,000.00

Draper fund: Gift of Mrs. Henry Draper, 1883, in memory of her husband, a former member of the academy. To found the Henry Draper gold medal, to be awarded for notable investigations in astronomical physics. The balance of income is applied to aid research in the same science 10,000.00

Smith fund: Gift of Mrs. J. Lawrence Smith, 1884, in memory of her husband, a former member of the academy. To found the J. Lawrence Smith gold medal, to be awarded for important investigations of meteoric bodies and to assist, by grants of money, researches concerning such objects 10,000.00

Gibbs fund: Established by a gift of Wolcott Gibbs, a member of the academy, 1892, and increased by a bequest of the late Morris Loeb, 1914. For the promotion of researches in chemistry 5,545.50

Gould fund: Gift of Miss Alice Bache Gould, 1897, in memory of her father, a former member of the academy. For the promotion of researches in astronomy 20,000.00

Comstock fund: Gift of Gen. Cyrus B. Comstock, a member of the academy, 1907. To promote researches in electricity, magnetism, or radiant energy, through the Comstock prize, of money, to be awarded once in five years for notable investigations. The fund is to be increased ultimately to $15,000 ..... 12,406.02

Marsh fund: Bequest of Othniel Charles Marsh, a member of the academy, 1909. To promote original research in the natural sciences. To the original bequest of $10,000 the academy has added interest received from the estate and authorized the increase of the fund to $20,000 by annual additions from income 18,500.00

Murray fund: A gift from Sir John Murray, 1911, to found the Alexander Agassiz gold medal, in honor of a former member and president of the academy, to be awarded for original contributions to the science of oceanography 6,000.00

Hartley fund: A gift from Mrs. Helen Hartley Jenkins, 1913–14, in memory of her father, Marcellus Hartley, to found the medal of the academy awarded for eminence in the application of science to the public welfare 1,200.00

Billings fund: Established by the bequest of Mrs. Mary Anna Palmer Draper (Mrs. Henry Draper), of $25,000, 1915. To support the publication of the Proceedings of the academy or for other purposes to be determined by the academy. First installment 2,500.00

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Elliot fund: Gift of Margaret Henderson Elliot to found the Daniel Giraud Elliot gold medal and honorarium, for the most meritorious work in zoology or paleontology published in each year.. $8,000.00

In addition to the above-named trust funds the academy holds the following:

Agassiz fund: Bequest of Alexander Agassiz, a member of the academy, 1910, for the general uses of the academy..... $50,000.00

Building fund: A gift from Alexander Agassiz and Theodore N. Gill, former members of the academy, toward a building for the academy, together with accumulated income..... 9,000.00

STATEMENTS OF ASSETS AND LIABILITIES, DECEMBER 31, 1917.

ASSETS.

1. Mortgage notes, secured by first mortgages on real estate.....		$85,750.00
2. Bonds, giving name, face value, rate of interest, and cost:		
4 American Telephone & Telegraph Co., collateral fives, due Dec. 1, 1946. 4 at $1,000. Nos. 640, 29245, 29246, 41419.....	$3,817.50	
5 Asheville Power & Light Co., first mortgage 30-year gold, 5 per cent, due Apr. 1, 1942, New York. 5 at $1,000. Nos. 272, 490, 492, 508, 509.....	4,892.50	
12 Broadway Realty Co., first 5 per cent gold, due Sept. 1, 1926. 12 at $1,000 face value. Nos. 38, 50, 796, 963–5, 1068, 1616–20. Purchase money..	12,345.00	
10 Bush Terminal Buildings Co., first mortgage, 50-year sinking fund, 5 per cent gold bonds, due Apr. 1, 1960. 10 at $1,000 face value. Nos. 1383–7 and 2805–9.....	9,375.00	
5 Chesapeake & Ohio, general mortgage, 4.5's gold bonds, due New York, Mar. 1, 1992. 5 at $1,000. Nos. 15350, 15351, 15352, 15353, 15354.....	4,600.00	
4 City of Tacoma, Green River special water fund No. 2, 5 per cent, due Oct. 1, 1939. 4 at $1,000. Nos. 1508, 1509, 1510, 1511.....	4,140.00	
12 Cleveland Electric & Illuminating Co., first mortgage, 5 per cent gold bonds, due New York, Apr. 1, 1939. 4 at $500 and 8 at $1,000. Nos. M6060, M6069, M6097, M15094–15098, D261, D262, D263, D264.....	9,597.50	
19 Cosmos Club, 4.5 per cent bonds, due July 1. 1949. 19 at $1,000. Nos. 286–297, 299, 301–305, 350.....	19,000.00	
7 Detroit Edison Co., 5's, first mortgage, 30-year, gold, due Jan. 1, 1933. 7 at $1,000. Nos. 557, 2442, 2443, 3024, 3252, 3253, 3086.....	7,177.50	
5 Dominion Coal Co. (Ltd.), first mortgage, sinking-fund gold bonds, 5 per cent, due New York, May 1, 1940. 5 at $1,000. Nos. A1036–A1040..	4,675.00	

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8	Galveston, Harrisburg and San Antonio, Mexican & Pacific Ex., second guaranteed 5's, due Jan. 1, 1931. 8 at $1,000. Nos. 1044, 1048, 1248, 2112–2116	$8,030.00
2	Georgia Ry. & Electric Co., first consolidated mortgage, 5's, sinking-fund gold, due Jan. 1, 1932. 2 at $1,000. Nos. 1061, 1600	2,055.00
13	Government of the Province of Alberta 4.5 per cent, 10-year gold debenture, due New York, Feb. 1, 1924. 11 at $100; Nos. 1501–1511. 2 at $500; Nos. 2031, 2032, $2,100	2,008.50
6	Government of the Province of Alberta, 5 per cent, 10-year gold debenture, due New York, May 1, 1925. 1 at $1,000; No. 2364. 5 at $500. Nos. B189–B193. $3,500	3,373.75
1	Government of the Province of Alberta, 4.5 per cent, 10-year gold debenture, due New York, Dec. 1, 1923. 1 at $500. No. 2620	480.00
4	Grand Rapids Gas Light Co., 5 per cent, first mortgage, gold, due New York, Aug. 1, 1939. 4 at $1,000. Nos. A522, A523, A595, A596	4,020.00
9	Milwaukee Railway & Electric Light Co., general and refunding mortgage gold, series A, 5 per cent, due New York Dec. 1, 1951. 9 at $1,000. Nos. 2088, 2772, 3839, 3840, 3930, 3931, 5222, 5223 5224	8,237.50
10	Minneapolis General Electric Co., 5 per cent, 30-year gold-mortgage. due New York, Dec. 1, 1934. 10 at $1,000. Nos. 1621, 1622, 1949, 2004, 2572, 2573, 2574, 2575, 7579, 7580	9,890.00
4	Niagara Falls Power Co., first mortgage, 5's, gold coupon, due Jan. 1, 1932. 4 at $1,000. Nos. 5246, 5247, 6583, 8358	4,100.00
18	Riggs Realty Co., 3/30-year coupon, first 5's, due Washington, D. C., Oct. 1, 1940. 18 at $1,000. Nos. 76, 80, 84, 88, 92, 96, 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140, 144	18,572,50
1	Shawinigan Water & Power Co., 5's, due Jan. 1, 1934. 1 at $500. No. 5337	507.50
9	Southern Bell Telephone & Telegraph Co., 30-year, first mortgage, 5's, sinking fund, gold, due Jan. 1, 1941. 9 at $1,000. Nos. M9739, M11576, M11577, M11578, M11579, L13965, M15568, M15569, M15570	8,942.50
1	Union Electric Light & Power Co. of St. Louis, 5 per cent, first mortgage, 30-year, gold, due New York, Sept. 1, 1932. 1 at $1,000. No. 4169	1,010.00
5	Vicksburg, Shreveport & Pacific R. R. Co., prior lien mortgage, at 6 per cent, gold, renewed at 5 per cent, due Nov. 1, 1915; extended to Nov. 1, 1940. 5 at $1,000. Nos. 561, 661, 794, 982, 1323	5,050.00

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7 Virginian Ry. Co., first mortgage, 50-year gold, 5 per cent, due New York, Nov. 1, 1962. 7 at $1,000. Nos. M4290, M4291, M14151, M23824, M23823, M23822, M23821	$6,986.25	
		$162,873.50
3. Bank balance, Dec. 31, 1917[1]		16,865.30
		265,488.80

LIABILITIES.

	Income.	Capital.
General fund:		
Invested	$4,686.25	
Uninvested	602.99	
Agassiz fund:		
Invested		$50,000.00
Uninvested		
Bache fund:		
Invested	2,575.00	56,000.00
Uninvested	1,249.76	
Billings fund:		
Invested		2,500.00
Uninvested		
Building fund:		
Invested		9,000.00
Uninvested	399.29	
Comstock fund:		
Invested	677.50	12,318.75
Uninvested	854.25	87.27
Consolidated fund:		
Invested		
Uninvested	1,097.53	
Draper fund:		
Invested	1,952.50	10,000.00
Uninvested	534.89	
Elliot fund:		
Invested		8,000.00
Uninvested	517.22	
Gibbs fund:		
Invested		5,545.50
Uninvested	216.33	
Gould fund:		
Invested	4,067.50	19,942.50
Uninvested	1,642.67	57.50
Hale lectureship:		
Invested		
Uninvested	220.28	
Hartley fund:		
Invested		1,200.00
Uninvested	25.51	
Marsh fund:		
Invested		18,500.00
Uninvested	716.81	

[1] Outstanding checks, $901.86.

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	Income.	Capital.
Murray fund:		
Invested		$6,000.00
Uninvested	$569.61	
National Research Council:		
Invested		
Uninvested	2,389.35	
Proceedings:		
Invested		
Uninvested	1,922.27	
Smith fund:		
Invested	1,532.50	10,000.00
Uninvested	1,084.20	
Watson fund:		
Invested	1,003.75	24,796.25
Uninvested	799.32	203.75
	31,337.28	234,151.52
		31,337.28
		265,488.80
Consolidated investment fund:		
Invested		175,071.00
Uninvested	1,097.53	1,674.50

CONDENSED STATEMENT OF RECEIPTS AND EXPENDITURES, 1917.

RECEIPTS.

Balance, Jan. 1, 1917, as per last report		$29,551.64
Cash receipts:		
Total income from investments	[1] $11,711.87	
Mortgage notes paid	15,000.00	
Annual dues, 1916, 1917, 1918	795.00	
Interest on bank deposits	435.89	
William Ellery Hale lectureship	1,000.00	
Billings fund from Draper estate	2,500.00	
Contributions to Proceedings	2,480.00	
Subscriptions to Proceedings	1,105.57	
Reprints and separate numbers of Proceedings	939.29	
Cancellation of check for J. Voûte	200.50	
Return of grant to I. W. Bailey from Bache fund	300.80	
Return of grant to E. O. Hovey from Smith fund	525.00	
Receipts to credit National Research Council	6,487.20	
		43,481.12
Book transfers:		
Bond transfers	1,003.75	
Transfers on account of consolidated fund	10,275.82	
Transfers, income to capital	7,870.36	
Contribution from Hale lectureship to Proceedings	1,500.00	
Transfer from Billings fund income to Proceedings fund	87.55	
Distribution of income from consolidated fund	8,601.76	
		29,339.24
		102,372.00

[1] Interest to amount of $750 is due from an unsettled estate.

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EXPENDITURES.

Cash expenditures:		
Investment of capital	$33,615.00	
Investment of income	2,007.50	
Accrued interest on bonds purchased	260.34	
National Research Council	4,147.85	
		$40,030.69
Book transfers:		
Transfer of investments	1,003.75	
Distribution of income from consolidated fund	8,601.76	
Transfers from income to capital	7,870.36	
Transfers from various funds to consolidated fund	10,275.82	
Contribution Hale lectureship to Proceedings fund	1,500.00	
Transfer from Billings fund income to Proceedings fund	87.55	
		29,339.24
Payments from trust and other funds:		
Bache fund—		
H. W. Norris	100.00	
Irving W. Bailey	300.00	
J. P. Iddings	500.00	
F. A. Shull	500.00	
J. Voûte	216.40	
J. Voûte (canceled)	200.50	
F. A. Goodspeed	100.00	
T. H. Gronwall	100.00	
C. K. Drinker	350.00	
R. A. Daly	700.00	
Smith fund—		
G. P. Merrill	185.00	
C. C. Trowbridge	250.00	
S. A. Mitchell	400.00	
Draper fund—		
A. A. Michelson medal	213.12	
Marsh fund—		
J. M. Clarke	400.00	
Watson fund—		
J. A. Miller	250.00	
H. C. Wilson	325.00	
Gibbs fund—		
W. D. Haskins	200.00	
R. L. Datta	135.30	
Hartley fund—		
Medals	143.80	
Gould fund—		
Astronomical Journal	500.00	
General fund—		
Grant for tables of constants	200.00	
Hale lectureship fund—		
Honorarium	300.00	
		6,569.12

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Proceedings:		
Stationery	$37.09	
Salary, managing editor	750.00	
Printing and distributing	4,948.47	
Expenses, Boston office	412.50	
Rent of meeting room	3.00	
Expenses, Washington office	62.45	
		$6,213.51
General fund:		
Salary assistant secretary and treasurer	600.00	
Treasurer's office	190.00	
Home secretary's office	716.74	
Foreign secretary's office	59.33	
Memoirs, printing, etc	76.75	
Meetings—		
Annual	841.35	
Autumn	90.69	
Reception to French scientific mission	291.65	
Postage, telegrams	82.33	
Election of members	113.57	
Panama Canal slide report	291.73	
		3,354.14
		85,506.70
Balance, Dec. 31, 1917		16,865.30
		102,372.00

ACCOUNTS WITH INDIVIDUAL FUNDS JAN. 1 TO DEC. 31, 1917.

	General fund.		Agassiz fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1917:				
Cash	$1,006.96			
Invested	4,686.25			$50,000.00
Receipts:				
Interest on deposits	435.89			
Interest on investments	2,714.28			
	8,843.38			50,000.00
Disbursements:				
General expenses	3,354.14			
Grants and medals	200.00			
Balance Dec. 31, 1917:				
Cash	602.99			
Invested	4,686.25			50,000.00
	8,843.38			50,000.00

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Accounts with individual funds Jan. 1 to Dec. 31, 1917—Continued.

	Bache fund.		Billings fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1917:				
Cash	$899.35			
Invested	2,575.00	$56,000.00		$2,500.00
Receipts:				
Interest on investments	2,916.01		$87.55	
J. Voûte, canceled check	200.50			
Irving W. Bailey, return of grant	300.80			
	6,891.66	56,000.00	87.55	2,500.00
Disbursements:				
Grants and medals	2,850.00			
J. Voûte check canceled	200.50			
Expense cable to J. Voûte	16.40			
Transfer capital to consolidated				2,500.00
Transfer to Proceedings			87.55	
Balance Dec. 31, 1917:				
Cash	1,249.76			
Invested	2,575.00	56,000.00		
	6,891.66	56,000.00	87.55	2,500.00

	Building fund.		Comstock fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1917:				
Cash			$1,297.32	$22.50
Invested		$8,954.03	677.50	11,315.00
Receipts:				
Interest on investments	$445.26		638.50	
Transfer income to capital				1,068.52
Transfer capital to consolidated		45.97		
	445.26	9,000.00	2,613.32	12,406.02
Disbursements:				
General expenses			13.05	
Transfer income to capital	45.97		64.77	
Transfer capital to consolidated			1,003.75	
Balance Dec. 31, 1917:				
Cash	399.29		854.25	87.27
Invested		9,000.00	677.50	12,318.75
	445.26	9,000.00	2,613.32	12,406.02

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Accounts with individual funds Jan. 1 to Dec. 31, 1917—Continued.

	Consolidated fund.		Draper fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1917:				
Cash	$1,742.30	$8,161.18	$245.19	
Invested		151,666.00	1,952.50	$10,000.00
Receipts:				
Interest on investments	8,071.03		502.82	
Transfers from various funds		16,918.32		
	9,813.33	176,745.50	2,700.51	10,000.00
Disbursements:				
Grants and medals			213.12	
Distribution income consolidated	8,715.80			
Balance Dec. 31, 1917:				
Cash	1,097.53	1,674.50	534.89	
Invested		175,071.00	1,952.50	10,000.00
	9,813.33	176,745.50	2,700.51	10,000.00

	Elliot fund.		Gibbs fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1917:				
Cash	$114.98		$272.25	
Invested		$8,000.00		$5,545.50
Receipts:				
Interest on investments	402.24		279.44	
	517.22	8,000.00	551.69	5,545.50
Disbursements:				
Grants and medals			319.00	
Expense cable to R. L. Datta			16.36	
Balance Dec. 31, 1917:				
Cash	517.22		216.33	
Invested		8,000.00		5,545.50
	517.22	8,000.00	551.69	5,545.50

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Accounts with individual funds Jan. 1, to Dec. 31, 1917—Continued.

	Gould fund.		Hale lectureship fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1917:				
Cash	$929.06	$2,036.25	$1,000.00	.....
Invested	4,067.50	17,963.75	.....	.....
Receipts:				
Interest on investments	1,247.50	.....	33.33	.....
Transfer of investment	.....	.....	1,003.75	.....
Contribution to Hale lectureship	.....	.....	1,000.00	.....
	6,244.06	20,000.00	3,037.08	.....
Disbursements:				
General expenses	33.89	.....	13.05	.....
Grants and medals	500.00	.....	.....	.....
Transfer to Proceedings fund	.....	.....	1,500.00	.....
E. G. Conklin, Honorarium	.....	.....	300.00	.....
Investment of income	.....	.....	1,003.75	.....
Balance Dec. 31, 1917:				
Cash	1,642.67	57.50	220.28	.....
Invested	4,067.50	19,942.50	.....	.....
	6,244.06	20,000.00	3,037.08	.....

	M. Hartley fund.		Marsh fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1917:				
Cash	$108.98	.....	$8,031.95	.....
Invested	.....	$1,200.00	677.50	$10,127.65
Receipts:				
Interest on investments	60.33	.....	779.71	.....
Capital from income	.....	.....	.....	8,372.35
	169.31	1,200.00	9,489.16	18,500.00
Disbursements:				
Grants and medals	143.80	.....	400.00	.....
Income from capital	.....	.....	8,372.35	.....
Balance Dec. 31, 1917:				
Cash	25.51	.....	716.81	.....
Invested	.....	1,200.00	.....	18,500.00
	169.31	1,200.00	9,489.16	18,500.00

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Accounts with individual funds Jan. 1, to Dec. 31, 1917—Continued.

	Murray fund.		National Research Council.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1917:				
Cash	$274.97	$35.00	$50.00	.....
Invested	.....	5,965.00	.....	.....
Receipts:				
Interest on investments	294.64	.....	.....	.....
Contributions, National Research Council	.....	.....	6,487.20	.....
	569.61	6,000.00	6,537.20	.....
Disbursements	.....	.....	4,147.85	.....
Balance Dec. 31, 1917:				
Cash	569.61	.....	2,389.35	.....
Invested	.....	6,000.00	.....	.....
	569.61	6,000.00	6,537.20	.....

	Proceedings fund:		Smith fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1917:				
Cash	$1,228.37	.....	$841.38	.....
Invested	.....	.....	1,532.50	$10,000.00
Receipts:				
Interest on investments	.....	.....	552.82	.....
E. O. Hovey, return of grant	.....	.....	525.00	.....
Billings fund income	87.55	.....	.....	.....
Hale lectureship to Proceedings fund	1,500.00	.....	.....	.....
Contributions to Proceedings	2,480.00	.....	.....	.....
Subscriptions to Proceedings	1,105.57	.....	.....	.....
Reprints and separate numbers	939.29	.....	.....	.....
Annual dues	795.00	.....	.....	.....
	8,135.78	.....	3,451.70	10,000.00
Disbursements:				
General expenses	6,213.51	.....	.....	.....
Transfer income to capital	.....	.....	835.00	.....
Balance Dec. 31, 1917:				
Cash	1,922.27	.....	1,084.20	.....
Invested	.....	.....	1,532.50	10,000.00
	8,135.78	.....	3,451.70	10,000.00

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Accounts with individual funds Jan. 1, to Dec. 31, 1917—Continued.

	Watson fund.	
	Income.	Capital.
Balance Jan. 1, 1917:		
Cash	$1,176.15	$77.50
Invested	.....	24,922.50
Receipts:		
Interest on investments	1,201.92	.....
	2,378.07	25,000.00
Disbursements:		
Transfer income to capital	575.00	.....
Balance Dec. 31, 1917:		
Cash	799.32	203.75
Invested	1,003.75	24,796.25
	2,378.07	25,000.00

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REPORT OF THE AUDITING COMMITTEE.

WASHINGTON, D. C., *January 14, 1918.*

We have employed the Capital Audit Co. to scrutinize and report on the treasurer's books. We accepted the certification, dated January 12, 1918, of the American Security & Trust Co. regarding notes on deposit owned by the academy, and we have examined the securities and papers contained in the box of the National Academy of Sciences at the vault of the American Security & Trust Co. We find them to correspond to the list checked by the auditing committee on January 17, 1917, except as modified by transactions of the year 1917 reported by the Capital Audit Co. We find that the coupons due in 1917 have been cut and are accounted for, and those due January 1, 1918, are detached and are accounted for by appropriate entries in the pass books. We find that interest on loans has been accounted for. Correspondence between vouchers, pass books, and accounts of the treasurer is certified by the Capital Audit Co. We find the balance reported by the treasurer as of December 31, 1917, to accord with the statement of the American Security & Trust Co. and with the check book.

C. G. ABBOT, *Chairman.*
W. F. DURAND,
ARTHUR L. DAY.

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APPENDIXES.

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APPENDIX A.

CONSTITUTION OF THE NATIONAL ACADEMY.

As amended and adopted April 17, 1872, and further amended April 20, 1875; April 21, 1881; April 19, 1882; April 18, 1883; April 19, 1888; April 18, 1895; April 20, 1899; April 17, 1902; April 18, 1906; November 20, 1906; April 17, 1907; November 20, 1907; April 20, 1911; April 16, 1912; April 21, 1915.

PREAMBLE.

Empowered by the act of incorporation enacted by Congress, and approved by the President of the United States on the 3d day of March, A. D. 1863, and in conformity with amendments to said act approved July 14, 1870, June 20, 1884, and May 27, 1914, the National Academy of Sciences adopts the following amended constitution and rules:

ARTICLE I.—OF MEMBERS.

SECTION 1. The academy shall consist of members, honorary members, and foreign associates. Members must be citizens of the United States.

SEC. 2. Members who, from age or inability to attend the meetings of the academy, wish to resign the duties of active membership, may, at their own request, be transferred to the roll of honorary members by a vote of the academy.

SEC. 3. The academy may elect 50 foreign associates.

SEC. 4. Honorary members and foreign associates shall have the privilege of attending the meetings and of reading and communicating papers to the academy, but shall take no part in its business, shall not be subject to its assessments, and shall be entitled to a copy of the publications of the academy.

ARTICLE II.—OF THE OFFICERS.

SECTION 1. The officers of the academy shall be a president, a vice president, a foreign secretary, a home secretary, and a treasurer, all of whom shall be elected for a term of six years, by a majority of votes present, at the first stated meeting after the expiration of the current terms, provided that existing officers retain their places until their successors are elected. In case of a vacancy, the election for six years shall be held in the same manner at the meeting when such

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vacancy occurs, or at the next stated meeting thereafter, as the academy may direct. A vacancy in the office of treasurer or home secretary may, however, be filled by appointment of the president of the academy until the next stated meeting of the academy.

SEC. 2. The officers of the academy, together with six members to be elected by the academy, shall constitute a council for the transaction of such business as may be assigned to them by the constitution or the academy.

SEC. 3. The president of the academy, or, in case of his absence or inability to act, the vice president, shall preside at the meetings of the academy and of the council; shall name all committees except such as are otherwise especially provided for; shall refer investigations required by the Government of the United States to members especially conversant with the subjects and report thereon to the academy at its meeting next ensuing; and, with the council, shall direct the general business of the academy.

It shall be competent for the president, in special cases, to call in the aid, upon committees, of experts or men of special attainments not members of the academy.

The president shall be, ex officio, a member of all committees empowered to consider questions referred to the academy by the Government of the United States.

SEC. 4. The foreign and home secretaries shall conduct the correspondence proper to their respective departments, advising with the president and council in cases of doubt, and reporting their action to the academy at one of the stated meetings in each year.

It shall be the duty of the home secretary to give notice to the members of the place and time of all meetings, of all nominations for membership, and of all proposed amendments to the constitution.

It shall be the duty of the home secretary to keep the minutes of each business and scientific session, and after approval to enter these upon the permanent records of the academy.

SEC. 5. The treasurer shall attend to all receipts and disbursements of the academy, giving such bond and furnishing such vouchers as the council may require. He shall collect all dues, assessments, and subscriptions, and keep a set of books showing a full account of receipts and disbursements and the condition of all funds of the academy. He shall be the custodian of the corporate seal of the academy.

ARTICLE III.—OF THE MEETINGS.

SECTION 1. That the academy shall hold one stated meeting, called the annual meeting, in April of each year in the city of Washington, and another stated meeting, called the autumn meeting, at a place to be determined by the council. The council shall also have power to fix the date of each meeting.

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Special business meetings of the academy may be called, by order of eight members of the council, at such place and time as may be designated in the call.

Special scientific meetings of the academy may be held at times and places to be designated by a majority of the council.

SEC. 2. The names of the members present at each session of a meeting shall be recorded in the minutes, and the members present at any session shall constitute a quorum for the transaction of business.

SEC. 3. Scientific sessions of the academy, unless otherwise ordered by a majority of the members present, shall be open to the public; sessions for the transaction of business shall be closed.

SEC. 4. Stated meetings of the council shall be held during the stated or special meetings of the academy and four members shall constitute a quorum for the transaction of business. Special meetings of the council may be convened at the call of the president and two members of the council, or of four members of the council.

SEC. 5. No member whose dues are in arrears shall vote at any business meeting of the academy.

ARTICLE IV.—OF ELECTIONS AND RESIGNATIONS.

SECTION 1. All elections of officers and members shall be by ballot, and each election shall be held separately.

SEC. 2. The time for holding an election of officers shall be fixed by the academy at least one day before the election is held.

SEC. 3. The election of the six members of the council shall be as follows:

At the annual meeting in April, 1907, six members of the council to be elected, of whom two shall serve for three years, two for two years, and two for one year, their respective terms to be determined by lot. Each year thereafter the terms of two members shall expire, and their successors, to serve for three years, shall be elected at the annual meeting in each year.

SEC. 4. The academy shall be divided by the council into sections representing the principal branches of scientific research. Each section shall elect its own chairman, who shall serve for three years. The chairman shall be responsible to the academy for the work of his section.

Nominations to membership in the academy shall be made in writing and approved by a majority of the members of the section on the branch of research in which the person nominated is eminent, or by a majority of the council in case there is no section on the subject. The nomination shall be sent to the home secretary by the chairman of the section before January 1 of the year in which the election is

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to be held, and each nomination shall be accompanied by a list of the principal contributions of the nominee to science. This list shall be printed by the home secretary for distribution among the members of the academy.

SEC. 5. Election of members shall be held at the annual meeting in Washington in the following manner: There shall be two ballots—a preference ballot, which may be prepared either before or at the annual meeting and must be transmitted to the home secretary, and a final ballot, to be taken at the meeting.

Preference ballot.—Each member may inscribe on a ballot not more than 15 names of nominees selected from the submitted list. A list of the nominees shall then be prepared, on which the names shall be entered in the order of the number of votes received by each. In case two or more nominees have the same number of votes on this preference list, the order in which they shall be placed on the list shall be determined by a majority vote of members present.

Final ballot.—A vote shall first be taken on the nominee who appears first on the preference list, and he shall be declared elected if he receive two-thirds of the votes cast and not less than 25 votes in all. A vote shall then be taken in similar manner on the nominee standing second on the preference list, and so on until all the nominees on the preference list shall have been acted on, or until 15 nominees shall have been elected or until the total membership of the academy shall have reached 250.

Not more than 15 members shall be elected at one annual meeting.

Before and during elections a discussion of the merits of nominees will be in order.

SEC. 6. Every member-elect shall accept his membership, personally or in writing, before the close of the next stated meeting after the date of his election. Otherwise, on proof that the secretary has formally notified him of his election, his name shall not be entered on the roll of members.

SEC. 7. Foreign associates may be nominated by the council and may be elected at the annual meeting by a two-thirds vote of the members present.

SEC. 8. A diploma, with the corporate seal of the academy and the signatures of the officers, shall be sent by the appropriate secretary to each member on his acceptance of membership, and to foreign associates on their election.

SEC. 9. Resignations shall be addressed to the president and acted on by the academy.

SEC. 10. Whenever a member has not paid his dues for four successive years, the treasurer shall report the fact to the council, which may report the case to the academy with the recommendation that the person thus in arrears be declared to have forfeited his membership.

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If this recommendation be approved by two-thirds of the members present, the said person shall no longer be a member of the academy and his name shall be dropped from the roll.

ARTICLE V.—SCIENTIFIC COMMUNICATIONS, PUBLICATIONS, AND REPORTS.

SECTION 1. Communications on scientific subjects shall be read at scientific sessions of the academy, and papers by any member may be read by the author or by any other member, notice of the same having been previously given to the secretary.

SEC. 2. Any member of the academy may read a paper from a person who is not a member, and shall not be considered responsible for the facts or opinions expressed by the author, but shall be held responsible for the propriety of the paper.

Persons who are not members may read papers on invitation of the council or of the committee of arrangements.

SEC. 3. The academy may provide for the publication, under the direction of the council, of proceedings, scientific memoirs, biographical memoirs, and reports.

The proceedings shall include the transactions of the academy, brief original announcements of the results of scientific investigations made by members of the academy or others, together with short original articles giving a comprehensive survey of the more important scientific researches currently made by American investigators, and other matters of general scientific interest.

The scientific memoirs shall provide opportunity for the publication of longer and more detailed scientific investigations.

The biographical memoirs shall contain an appropriate record of the life and work of deceased members of the academy.

An annual report shall be presented to Congress by the president and shall contain the annual reports of the treasurer and the auditing committee, a suitable summary of the reports of the committees in charge of trust funds, and a record of the activities of the academy for the calendar year immediately preceding, and other appropriate matter. This report shall be presented to Congress by the president after authorization by the council. It shall also be presented to the academy at the annual meeting next following.

The treasurer shall prepare a full report of the financial affairs of the academy at the end of the fiscal year. This report shall be submitted to the council for approval and afterwards presented to the academy at the annual meeting.

SEC. 4. Propositions for investigations or reports by the academy shall be submitted to the council for approval, except those requested by the Government of the United States, which shall be acted on by the president, who will in such cases report their results to the Gov-

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ernment as soon as obtained and to the academy at its next following stated meeting.

SEC. 5. The advice of the academy shall be at all times at the disposition of the Government upon any matter of science or art within its scope.

ARTICLE VI.—OF THE PROPERTY OF THE ACADEMY.

SECTION 1. All investments and reinvestments of either principal or accumulations of income of the trust and other funds of the academy shall be made by the treasurer, with the approval of the finance committee, in the corporate name of the academy, in the manner and in the securities designated or specified in the instruments creating the several funds, or, in the absence of such designation or specification, in bonds of the United States or of the several States, or in bonds or notes secured by first mortgages on real estate, in investments legal for savings banks under the laws of Massachusetts or New York, or in other bonds recommended to the treasurer by the fiscal advisers of the academy.

The treasurer may invest the capital of all trust funds of the academy which are not required by the instruments creating such funds to be kept separate and distinct, in a consolidated fund, and shall apportion the income received from such consolidated fund among the various funds composing the same in the proportion that each of said funds shall bear to the total amount of funds so invested; provided, however, that the treasurer shall at all times keep accurate accounts showing the amount of each trust fund, the proportion of the income from the consolidated fund to which it is entitled, and the expenses and disbursements properly chargeable to such fund.

SEC. 2. The council shall at its annual meeting in each year designate one bank or trust company in Washington, D. C., and one in New York City to act, when requested by the treasurer, as the fiscal advisers of the academy.

SEC. 3. The treasurer shall have authority, with the approval of the finance committee, to sell, transfer, convey, and deliver in the corporate name and for the benefit of the academy any stocks, bonds, or other securities standing in the corporate name.

SEC. 4. No contract shall be binding upon the academy which has not been first approved by the council.

SEC. 5. The assessments required for the support of the academy shall be fixed by the academy on the recommendation of the council and shall be payable within the calendar year for which they are assessed.

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ARTICLE VII.—OF TRUST FUNDS AND THEIR ADMINISTRATION.

SECTION 1. Devises, bequests, donations, or gifts having for their object the promotion of science or the welfare of the academy may be accepted by the council for the academy. Before the acceptance of any such trust the council shall consider the object of the trust and all conditions or specifications attaching thereto. The council shall make a report of its action to the academy.

SEC. 2. Medals and prizes may be established in accordance with the provisions of trusts or by action of the academy.

SEC. 3. Unless otherwise provided by the deed of gift, the income of each trust fund shall be applied to the objects of that trust by the action of the academy on the recommendation of a standing committee on that fund.

ARTICLE VIII.—OF ADDITIONS AND AMENDMENTS

Additions and amendments to the constitution shall be made only at a stated meeting of the academy. Notice of a proposition for such a change must be submitted to the council, which may amend the proposition, and shall report thereon to the academy. Its report shall be considered by the academy in committee of the whole for amendment.

The proposition as amended, if adopted in committee of the whole, shall be voted on at the next stated meeting, and if it receives two-thirds of the votes cast it shall be declared adopted.

Absent members may send their votes on pending changes in the constitution to the home secretary in writing, and such votes shall be counted as if the members were present.

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APPENDIX B.

RULES.

(In accordance with a resolution of the academy, taken at its meeting on April 21, 1915, the rules are arranged in groups and each group is numbered to correspond with the article of the constitution to which it relates.)

I.

1. The holders of the medal for emience in the application of science to the public welfare shall be notified, like members, of the meetings of the academy, and invited to participate in its scientific sessions.

II.

1. The proper secretary shall acknowledge all donations made to the academy, and shall at once report them to the council for its consideration.

2. The home secretary shall be the custodian of all books, apparatus, archives, and collections not explicitly assigned to other care.

3. The home secretary shall keep a record of all grants of money or awards of prizes or medals made from trust funds of the academy. The record for each grant of money shall include the following items:

1. Name of fund.
2. Date and number of the grant.
3. Name and address of recipient.
4. Amount of grant and date or dates of payment.
5. Purpose of grant.
6. Record or report of progress.
7. Resulting publications.

4. The treasurer shall keep the home secretary informed of all warrants received from directors of trust funds not controlled by the academy and of the date or dates of payment of all warrants.

5. The treasurer is authorized to defray, when approved by the president, all the proper expenses of committees appointed to make scientific investigations at the request of departments of the Government, and in each case to look to the department requesting the investigation for reimbursement to the academy.

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III.

1. The annual meeting of the academy shall begin on the fourth Monday of April. At the business sessions of the academy the order of procedure shall be as follows:

1. Chair taken by the president, or, in his absence, by the vice president.
2. Roll of members called by home secretary (first session of the meeting only).
3. Minutes of the preceding session read and approved.
4. Stated business.
5. Reports of president, secretaries, treasurer, and committees.
6. Business from council.
7. Other business.

2. The rules of order of the academy shall be those of the Senate of the United States, unless otherwise provided by the constitution or rules of the academy.

3. In the absence of any officer a member shall be chosen to perform his duties temporarily, by a plurality of *viva voce* votes, upon open nomination.

4. At each meeting the president shall announce the death of any members since the preceding meeting. As soon as practicable thereafter he shall designate a member to write—or to secure from some other source approved by the president—a biographical notice of each deceased member.

5. A standing committee of three members called the program committee, a local committee of five members appointed for each meeting, and the home secretary shall together constitute the committee of arrangements, of which the home secretary shall be chairman.

The term of service on the program committee shall be three years, one member retiring annually, the chairman to be designated by the president.

It shall be the duty of the program committee to prepare the scientific program for the annual meeting, and for this purpose it shall be empowered to solicit papers from members or others. It shall also be empowered to ascertain the length of time required for reading papers to be presented at the scientific sessions of the academy, and, when it appears advisable to limit the time to be occupied in their presentation or discussion.

The local committee shall meet not less than two months previous to each meeting. It shall prepare the detailed program of each day, and in general shall have charge of all business and scientific arrangements for the meeting for which it is appointed except those

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specifically assigned to the program committee in the case of the annual meeting.

IV.

1. The term of service of each chairman of a section shall be three years, to date from the closing session of the April meeting next following his election. Chairmen of sections shall be chosen by mail ballot, the member receiving the highest number of votes cast to be deemed elected. It shall be the duty of each retiring chairman to conduct the election of his successor and to report the result of the election to the home secretary before the April meeting at which his term of service expires. Should any section fail to elect a chairman before November 1, the president is empowered to appoint a temporary chairman to serve until the April meeting next following. No chairman shall be eligible for reelection for two consecutive terms.

2. The chairman of each section of the academy shall submit to the members of his section, not later than November 1 of each year, a ballot containing the names of all those persons who received lot less than two votes in the nominating ballot of the preceding year and of any other persons who were newly proposed for consideration at that time. Each member of the section shall be expected to return this ballot to the chairman within two weeks with his signature and with crosses placed against the names of those persons whom he is prepared to indorse for nomination. Each member may also write upon the ballot in a place provided for the purpose any new names which he desires to have included in the ballot to be submitted to the section in the following year. The vote resulting from this ballot shall be regarded as informal.

The chairman shall then submit to the members of his section a new ballot showing the results of the informal vote; and each member shall be expected to return this ballot to the chairman with his signature and with crosses placed against the names of those persons whom he will indorse for nomination. In order to secure an adequate number of nominations, the chairman, when necessary, shall obtain by personal solicitation a fuller vote of his section or shall submit to the section a supplementary formal ballot.

The chairman shall then certify to the home secretary, prior to January 1, the names of those persons who have been voted for on the formal ballots by a majority of the members of the section, and shall furnish him a list of the publications of these nominees, as required by the constitution.

3. Nominations for membership shall give the full name, residence, and the official positions successively held by the candidate, in addition to the list of his contributions to science required by the constitution.

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4. Preference ballots for election of members shall be sealed in a blank envelope, which shall be inclosed in another bearing the name of the sender, and which shall be addressed to the home secretary. Such envelopes shall be opened only by the tellers. If in any case the tellers are unable to determine who cast a ballot, or if the latter contains more names than are to be voted for, the ballot shall be rejected, but minor defects in a ballot shall be disregarded when the intent of the voter is obvious.

5. All discussions of the claims and qualifications of nominees at meetings of the academy shall be held strictly confidential, and remarks and criticisms then made may be communicated to no person who was not a member of the academy at the time of the discussion.

V.

1. The publication of the proceedings shall be under the general charge of the council, which shall have final jurisdiction upon all questions of policy relating thereto. The preparation of the proceedings for publication shall be intrusted to an editorial board. This board shall consist of a chairman and a managing editor, both of whom shall be appointed by the council for definite terms of service; of the home secretary and foreign secretary *ex officiis*, and of a body of associate editors representing the various branches of science which are to be included in the scope of the proceedings. The managing editor, who may be a nonmember of the academy, shall receive a salary, which shall be fixed by the council. It shall be the duty of the managing editor to prepare the proceedings in detail for publication; but the chairman of the editorial board shall decide, in consultation with the managing editor, in regard to the acceptance, rejection, or substantial modification of papers offered for publication. The associate editors shall be appointed by the council, upon recommendation of the chairman of the editorial board, for a period of three years, one-third of them retiring annually. The home secretary and the foreign secretary shall be responsible for the distribution of the proceedings in their respective fields.

2. Memoirs may be presented at any time to the home secretary, who shall report the date of their reception at the next session; but no memoir shall be published unless it has been read or presented by title before the academy.

Before publication all biographical and scientific memoirs must be referred to the committee on publication, who may, if they deem best, refer any memoir to a special committee appointed by the president to determine whether the same should be published by the academy.

3. Memoirs shall date, in the records of the academy, from the date of their presentation to the academy, and the order of their presenta-

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tion shall be so arranged by the secretary that, so far as may be convenient, those upon kindred topics shall follow one another.

4. The annual report of the treasurer shall contain:

1. A concise statement of the source, object, and amount of all trust funds of the academy.
2. A condensed statement of receipts and expenditures.
3. A statement of assets and liabilities.
4. Accounts with individual funds.
5. Such other matter as he considers appropriate.

5. The accounts of the treasurer shall, between January 1 and January 15 of each year, be audited by a committee of three members to be appointed by the president at the autumn meeting of the academy. It shall be the duty of the auditing committee to verify the record of receipts and disbursements maintained by the treasurer and the agreement of book and bank balances; to examine all securities in the custody of the treasurer and to compare the stated income of such securities with the receipts of record; to examine all vouchers covering disbursements for account of the academy and the authority therefor and to compare them with the treasurer's record of expenditures; to examine and verify the account of the academy with each trust fund. The auditing committee may employ an expert accountant to assist the committee in the examination of the books of the treasurer. The annual report of the treasurer shall be published with that of the president to Congress. The reports of the treasurer and auditing committee shall be presented to the academy at the annual meeting.

VI.

1. All apparatus and other materials of permanent value purchased with money from any grant from a trust fund shall be the property of the academy unless specific exception is made in the grant or by subsequent action of the council or the directors of the trust fund concerned. Receipts for all such property shall be signed by the grantee and shall be forwarded to the home secretary. All apparatus and unused material of value acquired in this way shall be delivered to the home secretary on completion of the investigation for which the grant was made, or at any time on demand of the council, and the home secretary shall give an appropriate release therefor.

2. The books, apparatus, archives, and other collections of the academy shall be deposited in some safe place in the city of Washington. A list of the articles so deposited shall be kept by the home secretary, who is authorized to employ a clerk to take charge of them.

3. A stamp corresponding to the corporate seal of the academy shall be kept by the secretaries, who shall be responsible for the due marking of all books and other objects to which it is applicable.

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Labels or other proper marks of similar device shall be placed upon objects not admitting of the stamp.

4. The fiscal year of the academy shall end on December 31 of each year.

5. The standing committee on finance shall consist of the treasurer ex officio as chairman and two members to be appointed annually by the president.

VII.

1. Standing committees of the academy on trust funds the income of which is applied to the promotion of research shall consist of three or five members. In order to secure rotation in office in such committees, when not in conflict with the provisions of the deeds of gift, the term of service on a committee of three members shall be three years; on a committee of five members the term shall be five years.

2. The annual reports of the committees on research funds shall, so far as the academy has authority to determine their form, give a current number to each award, stating the name, position, and address of the recipient; the subject of research for which the award is made, and the sum awarded; and in later annual reports the status of the work accomplished under each award previously made shall be announced, until the research is completed, when announcement of its completion and, if published, the title and place of publication shall be stated, and the record of the award shall be reported as closed.

VIII.

1. Any rule of the academy may be amended, suspended, or repealed on the written motion of any two members, signed by them, and presented at a stated meeting of the academy, provided the same shall be approved by a majority of the members present.

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APPENDIX C.

ORGANIZATION OF THE ACADEMY, 1917–18.

	Expiration of term.
WALCOTT, CHARLES D., *President*	April, 1923
MICHELSON, A. A., *Vice President*	April, 1923
HALE, GEORGE E., *Foreign Secretary*	April, 1922
DAY, ARTHUR L., *Home Secretary*	April, 1919
CROSS, WHITMAN, *Treasurer*	April, 1923

ADDITIONAL MEMBERS OF COUNCIL.

1915–1918.

COULTER, J. M.
HOWELL, W. H.

1916–1919.

CHITTENDEN, R. H.
PUPIN, M. I.

1917–1920.

CONKLIN, E. G.
NOYES, A. A.

SECTIONS.

1. MATHEMATICS.

BLISS, G. A.
BÔCHER, MAXIME
BOLZA, OSKAR
DICKSON, L. E.
KASNER, EDWARD
MOORE, E. H.
OSGOOD, W. F.
STORY, W. E.
VAN VLECK, E. B. (*Chairman, 1916–1919*)
WHITE, H. S.

2. ASTRONOMY.

ABBOT, C. G.
ADAMS, W. S.
BARNARD, E. E.
CAMPBELL, W. W. (*Chairman, 1917–1920*)
COMSTOCK, G. C.
ELKIN, W. L.
FROST, E. B.
HALE, G. E.
LEUSCHNER, A. O.
MOULTON, F. R.
PICKERING, E. C.
SCHLESINGER, FRANK

3. PHYSICS.

ABBOT, H. L.
AMES, J. S.
BARUS, CARL
BELL, A. G.
BUMSTEAD, H. A.
CARTY, J. J.
CREW, HENRY
DURAND, W. F.
HALL, E. H.
HASTINGS, C. S.
HAYFORD, J. F.
LYMAN, THEODORE
MENDENHALL, T. C.
MERRITT, ERNEST
MICHELSON, A. A.
MILLIKAN, R. A.
NICHOLS, E. F. (*Chairman, 1917–1920*)
NICHOLS, E. L.
PUPIN, M. I,
ROSA, E. B.
SABINE, W. C.
STRATTON, S. W.
THOMSON, ELIHU
TROWBRIDGE, JOHN
WEBSTER, A. G.
WOOD, R. W.
WOODWARD, R. S.

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4. CHEMISTRY.

BAXTER, G. P.
BOGERT, M. T.
BOLTWOOD, B. B.
CHANDLER, C. F.
CLARKE, F. W.
FRANKLIN, E. C.
GOMBERG, MOSES
GOOCH, F. A.
HILLEBRAND, W. F.
HOWE, H. M.
JACKSON, C. L.
LEWIS, G. N.
MICHAEL, ARTHUR
MORLEY, E. W.
MORSE, H. N.
NOYES, A. A.
NOYES, W. A.
OSBORNE, T. B.
REMSEN, IRA
RICHARDS, T. W.
(Chairman, 1916–1919)
SMITH, ALEXANDER
SMITH, EDGAR F.
STIEGLITZ, JULIUS
WELLS, H. L.
WHITNEY, W. R.

5. GEOLOGY AND PALEONTOLOGY.

BECKER, G. F.
BRANNER, J. C.
CHAMBERLIN, T. C.
CLARKE, J. M.
(Chairman, 1918–1921)
CROSS, WHITMAN
DALL, W. H.
DANA, E. S.
DAVIS, W. M.
DAY, A. L.
GILBERT, G. K.
IDDINGS, J. P.
KEMP, J. F.
LINDGREN, WALDEMAR
OSBORN, H. F.
PIRSSON, L. V.
PUMPELLY, RAPHAEL
RANSOME, F. L.
REID, H. F.
SCHUCHERT, CHARLES
SCOTT, W. B.
VAN HISE, C. R.
ULRICH, E. O.
WALCOTT, C. D.
WHITE, DAVID
WILLISTON, S. W.

6. BOTANY.

BAILEY, L. H.
BRITTON, N. L.
CAMPBELL, D. H.
COULTER, J. M.
FARLOW, W. G.
GOODALE, G. L.
HARPER, R. A.
SARGENT, C. S.
SMITH, ERWIN F.
(Chairman, 1918–1921)
THAXTER, ROLAND
TRELEASE, WILLIAM

7. ZOOLOGY AND ANIMAL MORPHOLOGY.

ALLEN, J. A.
CASTLE, W. E.
CONKLIN, E. G.
DAVENPORT, C. B.
DONALDSON, H. H.
HARRISON, R. G.
HOWARD, L. O.
JENNINGS, H. S.
LILLIE, F. R.
MARK, E. L.
MAYER, A. G.
MERRIAM, C. H.
MORGAN, T. H.
MORSE, E. S.
PARKER, G. H.
(Chairman, 1916–1919)
PEARL, RAYMOND
RIDGWAY, ROBERT
VERRILL, A. E.
WHEELER, W. M.
WILSON, EDMUND B.

8. PHYSIOLOGY AND PATHOLOGY.

ABEL, J. J.
BENEDICT, F. G.
CANNON, W. B.
CHITTENDEN, R. H.
COUNCILMAN, W. T.
CUSHING, HARVEY
FLEXNER, SIMON
FOLIN, OTTO
HALSTEAD, W. S.
HOWELL, W. H.
(Chairman, 1916–1919)
LEVENE, P. A. T.
LOEB, JACQUES
LUSK, GRAHAM
MELTZER, S. J.
MENDEL, L. B.
PRUDDEN, T. M.
SMITH, THEOBALD
VAUGHAN, V. C.
WELCH, W. H.
WOOD, H. C.

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9. ANTHROPOLOGY AND PSYCHOLOGY.

BOAS, FRANZ
CATTELL, J. McK.
DEWEY, JOHN
FEWKES, J. W. (*Acting Chairman*)
HALL, G. S.
HOLMES, W. H.
THORNDYKE, E. L.

STANDING COMMITTEES.

ON WEIGHTS, MEASURES, AND COINAGE.

MENDENHALL, T. C. (*Chairman*)
MICHELSON, A. A.
MORLEY, E. W.
WEBSTER, A. G.
WOODWARD, R. S.

ON SOLAR RESEARCH.

HALE, G. E. (*Chairman*)
CAMPBELL, W. W.
MICHELSON, A. A.
NICHOLS, E. L.
PICKERING, E. C.

ON PUBLICATION.

The PRESIDENT.
The HOME SECRETARY.
ROSA, E. B.

EDITORIAL BOARD OF THE PROCEEDINGS.

PEARL, RAYMOND (*Chairman*)
WILSON, EDWIN B. (*Managing Editor*)
DAY, A. L. (*Home Secretary*)
HALE, G. E. (*Foreign Secretary*)

ABEL, J. J., 1918.	IDDINGS, J. P., 1918.	MOORE, E. H., 1920.
CLARKE, J. M., 1918.	LOEB, JACQUES, 1920.	NOYES, A. A., 1919.
DONALDSON, H. H., 1919.	LUSK, GRAHAM, 1919.	SMITH, ALEXANDER, 1918.
FROST, E. B., 1920.	MAYER, A. G., 1919.	THORNDIKE, E. L., 1920.
HARPER, R. A., 1919.	MILLIKAN, R. A., 1918.	WHEELER, W. M., 1920.

ON COLLECTION OF HISTORICAL PORTRAITS, MANUSCRIPTS, INSTRUMENTS, ETC.

WALCOTT, C. D. (*Chairman*)
CLARKE, F. W.
HALE, G. E.
MELTZER, S. J.
PUPIN, M. I.

ON PROGRAM.

ABBOT, C. G. (*Chairman*), 1918.
THORNDYKE, E. L., 1929.
PEARL, RAYMOND, 1920.

FINANCE COMMITTEE.

CROSS, WHITMAN (*Chairman*)
HOWARD, L. O.
WALCOTT, C. D.

TRUST FUNDS.

THE BACHE FUND.

[$56,000.]

Researches in physical and natural science.

FROST, E. B. (*Chairman*)
HARRISON, R. G.
WEBSTER, A. G.

THE WATSON FUND.

[$25,000.]

Watson medal and the promotion of astronomical research.

LEUSCHNER, A. O. (*Chairman*)
COMSTOCK, G. C.
ELKIN, W. L.

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THE HENRY DRAPER FUND.

[$10,000.]

Draper medal and investigations in astronomical physics.

CAMPBELL, W. W. (*Chairman*), 1919. ABBOT, C. G. 1921. AMES, J. S., 1920.
HALE, G. E., 1918. MICHELSON, A. A., 1922.

THE J. LAWRENCE SMITH FUND.

[$10,000]

J. Lawrence Smith medal and investigations of meteoric bodies.

MORLEY, E. W. (*Chairman*), 1919. DANA, E. S., 1918. CROSS, WHITMAN, 1922.
PICKERING, E. C., 1920. WOOD, R. W., 1921.

THE BARNARD MEDAL.[1]

Meritorious service to science.

WOODWARD, R. S. (*Chairman*) CAMPBELL, W. W. NICHOLS, E. F.
NOYES, A. A. RICHARDS, T. W.

THE BENJAMIN APTHORP GOULD FUND.

[$20,000.]

Researches in astronomy.

MOULTON, F. R. (*Chairman*) BARNARD, E. E. WOODWARD, R. S.

THE WOLCOTT GIBBS FUND.

[$5.545.50.]

Chemical research.

JACKSON, C. L. (*Chairman*) RICHARDS, T. W. SMITH, EDGAR F.

THE COMSTOCK FUND.

[$12,406. 02.]

Researches in electricity, magnetism, and radiant energy.

NICHOLS, E. L. (*Chairman*), 1918. MILLIKAN, R. A., 1921. NOYES, A. A., 1919.
THOMPSON, ELIHU, 1920. WEBSTER, A. G., 1922.

THE MARSH FUND.

[$18.500.]

Original research in the natural sciences.

MOORE, E. H. (*Chairman*), 1919. DANA, E. S., 1920.
SCHUCHERT, CHARLES, 1918.

THE AGASSIZ FUND.

[$50,000.]

General uses of the academy.

THE MURRAY FUND.

[$6,000.]

Agassiz medal and contributions to oceanography.

DALL, W. H. (*Chairman*), 1918. DAVIS, W. M., 1919. PARKER, G. H., 1920.

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[1] Every five years the committee recommends the person whom they consider most deserving of the medal, and upon the approval of the Academy the name of the nominee is forwarded to the trustees of Columbia University, who administer the Barnard Medal Fund.

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THE MARCELLUS HARTLEY FUND.

[$1,200.]

Medal for eminence in the application of science to the public welfare.

BECKER, G. F. (*Chairman*), 1919. HILLEBRAND, W. F., 1919.
OSBORN, H. F., 1918. PUPIN, M. I., 1918. SMITH, THEOBALD, 1920.
WEBSTER, A. G., 1920.

THE JOSEPH HENRY FUND.

To assist meritorious investigators, especially in the direction of original research.

The sum of $40,000 was contributed by Fairman Rogers, Joseph Patterson, George W. Childs, and others, as an expression of their respect and esteem for Prof. Joseph Henry. This amount was deposited with the Pennsylvania Co. for the Insurance of Lives and Granting Annuities in Trust, with authorization to collect the income thereon and to pay over the same to Prof. Joseph Henry during his natural life, and after his death to his wife and daughters, and after the death of the last survivor to "deliver the said fund and the securities in which it shall then be invested to the National Academy of Sciences, to be thenceforward forever held in trust under the name and title of the 'Joseph Henry fund.'"

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MEMBERS OF THE NATIONAL ACADEMY OF SCIENCES.

DECEMBER 31, 1917.

		Date of election.
ABBOT, CHARLES GREELEY	*Smithsonian Institution, Washington, D. C.*	1915
ABBOT, HENRY L., U. S. A	*23 Berkeley St., Cambridge, Mass.*	1872
ABEL, JOHN JACOB	*Johns Hopkins University, Baltimore, Md.*	1912
ADAMS, WALTER SYDNEY	*Solar Observatory Office, Pasadena, Cal.*	1917
ALLEN, J. ASAPH	*American Museum of Natural History, N. Y. City.*	1876
AMES, JOSEPH S	*Johns Hopkins University, Baltimore, Md.*	1909
BAILEY, LIBERTY HYDE	*Ithaca, N. Y.*	1917
BARNARD, E. E	*Yerkes Observatory, Williams Bay, Wis.*	1911
BARUS, CARL	*Brown University, Providence, R. I.*	1892
BAXTER, GREGORY PAUL	*T. J. Coolidge Jr. Mem. Lab., Cambridge, Mass.*	1916
BECKER, GEORGE F	*U. S. Geological Survey, Washington, D. C.*	1901
BELL, A. GRAHAM	*1331 Connecticut Ave., Washington, D. C.*	1883
BENEDICT, FRANCIS GANO	*Nutrition Laboratory, Boston, Mass.*	1914
BLISS, GILBERT AMES	*University of Chicago, Chicago, Ill.*	1916
BOAS, FRANZ	*Columbia University, New York City.*	1900
BOGERT, MARSTON TAYLOR	*1023 16th Street, Washington, D. C.*	1916
BÔCHER, MAXIME	*Harvard University, Cambridge, Mass.*	1909
BOLTWOOD, B. B	*Yale University, New Haven, Conn.*	1911
BOLZA, OSKAR	*Reichsgrafenstr. 10, Freiburg, Germany.*	1909
BRANNER, JOHN C	*Stanford University, California.*	1905
BRITTON, NATHANIEL LORD	*New York Botanical Gardens, N. Y. City.*	1914
BUMSTEAD, HENRY ANDREWS	*Yale University, New Haven, Conn.*	1913
CAMPBELL, D. H	*Stanford University, California.*	1910
CAMPBELL, WILLIAM W	*Lick Observatory, Mount Hamilton, California.*	1902
CANNON, WALTER BRADFORD	*Harvard University, Cambridge, Mass.*	1914
CARTY, JOHN J	*Am. Telegraph and Telephone Co., N. Y. City.*	1917
CASTLE, WILLIAM ERNEST	*186 Payson Road, Belmont, Mass.*	1915
CATTELL, JAMES MCK	*Garrison, N. Y.*	1901
CHAMBERLAIN, THOMAS C	*University of Chicago, Chicago, Ill.*	1903
CHANDLER, CHARLES F	*Columbia University, New York, N. Y.*	1874
CHITTENDEN, RUSSELL H	*Sheffield Scientific School, New Haven, Conn.*	1890
CLARKE, F. W	*U. S. Geological Survey, Washington, D. C.*	1909
CLARKE, J. M	*State Hall, Albany, N. Y.*	1909
COMSTOCK, GEORGE C	*Washburn Observatory, Madison, Wis.*	1899
CONKLIN, E. G	*Princton, N. J.*	1908
COULTER, J. M	*University of Chicago, Chicago, Ill.*	1909
COUNCILMAN, WILLIAM T	*Harvard Medical School, Boston, Mass.*	1904
CREW, HENRY	*Northwestern University, Evanston, Ill.*	1909
CROSS, WHITMAN	*2138 Bancroft Place, Washington, D. C.*	1908
CUSHING, HARVEY	*Harvard University, Cambridge, Mass.*	1917
DALL, WILLIAM H	*Smithsonian Institution, Washington, D. C.*	1897
DANA, EDWARD S	*Yale University, New Haven, Conn.*	1884

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		Date of election.
DAVENPORT, CHARLES B.	*Cold Spring Harbor, N. Y.*	1912
DAVIS, WILLIAM MORRIS	*31 Hawthorn St., Cambridge, Mass.*	1904
DAY, ARTHUR L.	*Geophysical Laboratory, Washington, D. C.*	1911
DEWEY, JOHN	*Columbia University, New York City.*	1910
DICKSON, LEONARD E.	*University of Chicago, Chicago, Ill.*	1913
DONALDSON, HENRY HERBERT	*Wistar Institute of Anatomy, Phila., Pa.*	1914
DURAND, WILLIAM FREDERICK	*Munsey Building, Washington, D. C.*	1917
ELKIN, WILLIAM L.	*Yale University Observatory, New Haven, Conn.*	1895
FARLOW, W. G.	*Harvard University, Cambridge, Mass.*	1879
FEWKES, JESSE WALTER	*Bureau of American Ethnology, Wash., D. C.*	1914
FLEXNER, SIMON	*Rockefeller Institute, New York City.*	1908
FOLIN, OTTO	*Harvard Medical School, Boston, Mass.*	1916
FRANKLIN, EDWARD CURTIS	*Stanford University, California.*	1914
FROST, EDWIN B.	*Yerkes Observatory, Williams Bay, Wis.*	1908
GILBERT, GROVE K.	*U. S. Geological Survey, Washington, D. C.*	1883
GOMBERG, MOSES	*University of Michigan, Ann Arbor, Mich.*	1914
GOOCH, FRANK A.	*Yale University, New Haven, Conn.*	1897
GOODALE, GEORGE L.	*Harvard University, Cambridge, Mass.*	1890
HALE, GEORGE E.	*Solar Observatory Office, Pasadena, Cal.*	1902
HALL, EDWIN H.	*Harvard University, Cambridge, Mass.*	1911
HALL, GRANVILLE STANLEY	*Clark University, Worcester, Mass.*	1915
HALSTED, WILLIAM STEWART	*Johns Hopkins Med. School, Baltimore, Md.*	1917
HARPER, R. A.	*Columbia University, New York City.*	1911
HARRISON, ROSS G.	*Yale University, New Haven, Conn.*	1913
HASTINGS, CHARLES S.	*Yale University, New Haven, Conn.*	1889
HAYFORD, JOHN F.	*Northwestern University, Evanston, Ill.*	1911
HILLEBRAND, WILLIAM F.	*Bureau of Standards, Washington, D. C.*	1908
HOLMES, WILLIAM H.	*U. S. National Museum, Washington, D. C.*	1905
HOWARD, LELAND OSSIAN	*U. S. Dept. of Agriculture, Washington, D. C.*	1916
HOWE, HENRY MARION	*Broad Brook Road, Bedford Hills, N. Y.*	1917
HOWELL, WILLIAM H.	*Johns Hopkins University, Baltimore, Md.*	1905
IDDINGS, JOSEPH P.	*U. S. Geological Survey, Washington, D. C.*	1907
JACKSON, CHARLES L.	*6 Boylston Hall, Cambridge, Mass.*	1883
JENNINGS, HERBERT SPENCER	*Johns Hopkins University, Baltimore, Md.*	1914
KASNER, EDWARD	*Columbia University, New York City.*	1917
KEMP, JAMES F.	*Columbia University, New York City.*	1911
LEUSCHNER, ARMIN O.	*University of California, Berkeley, Cal.*	1913
LEVENE, PHŒBUS AARON THEODOR	*Rockefeller Institute, New York City.*	1916
LEWIS, GILBERT N.	*University of California, Berkeley, Cal.*	1913
LILLIE, FRANK RATTRAY	*University of Chicago, Chicago, Ill.*	1915
LINDGREN, WALDEMAR	*Mass. Inst. of Technology, Cambridge, Mass.*	1909
LOEB, JACQUES	*Rockefeller Institute, New York City.*	1910
LUSK, GRAHAM	*Cornell University Medical College, New York City.*	1915
LYMAN, THEODORE	*Harvard University, Cambridge, Mass.*	1917
MARK, EDWARD L.	*109 Irving St., Cambridge, Mass.*	1903
MAYER, ALFRED GOLDSBOROUGH	*Carnegie Institution, Maplewood, N. J.*	1916
MELTZER, SAMUEL JAMES	*Rockefeller Institute, New York City.*	1912
MENDEL, LAFAYETTE B.	*18 Trumbull St., New Haven, Conn.*	1913
MENDENHALL, THOMAS C.	*329 North Chestnut St., Ravenna, Ohio.*	1887
MERRIAM, C. HART	*1919 16th St., Washington, D. C.*	1902
MERRITT, ERNEST	*Cornell University, Ithaca, N. Y.*	1914
MICHAEL, ARTHUR	*219 Parker St., Newton Center, Mass.*	1889

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		Date of election.
MICHELSON, ALBERT A.	*University of Chicago, Chicago, Ill.*	1888
MILLIKAN, ROBERT ANDREWS.	*University of Chicago, Chicago, Ill.*	1915
MOORE, ELIAKIM H.	*University of Chicago, Chicago, Ill.*	1901
MORGAN, T. H.	*Columbia University, New York City.*	1909
MORLEY, EDWARD W.	*West Hartford, Conn.*	1897
MORSE, EDWARD S.	*Salem, Mass.*	1876
MORSE, HARMON N.	*Johns Hopkins University, Baltimore, Md.*	1907
MOULTON, F. R.	*University of Chicago, Chicago, Ill.*	1910
NICHOLS, EDWARD L.	*Cornell University, Ithaca, N. Y.*	1901
NICHOLS, ERNEST F.	*Yale University, New Haven, Conn.*	1908
NOYES, ARTHUR A.	*Mass. Inst. of Technology, Cambridge, Mass.*	1905
NOYES, WILLIAM A.	*University of Illinois, Urbana, Ill.*	1910
OSBORN, H. F.	*American Museum of Natural History, New York City.*	1900
OSBORNE, T. B.	*Agricultural Experiment Station, New Haven, Conn.*	1910
OSGOOD, WILLIAM FOGG.	*Harvard University, Cambridge, Mass.*	1904
PARKER, GEORGE H.	*16 Berkeley St., Cambridge, Mass.*	1913
PEARL, RAYMOND.	*Maine Agricultural Experiment Station, Orono, Me.*	1916
PICKERING, EDWARD C.	*Harvard College Observatory, Cambridge, Mass.*	1873
PIRSSON, LOUIS V.	*41 Trumbull St., New Haven, Conn.*	1913
PRUDDEN, T. MITCHELL.	*Columbia University, New York City.*	1901
PUMPELLY, RAPHAEL.	*Gibbs Avenue, Newport, R. I.*	1872
PUPIN, MICHAEL I.	*Columbia University, New York City.*	1905
RANSOME, FREDERICK LESLIE.	*U. S. Geological Survey, Washington, D. C.*	1914
REID, H. FIELDING.	*Johns Hopkins University, Baltimore, Md.*	1912
REMSEN, IRA.	*Johns Hopkins University, Baltimore, Md.*	1882
RICHARDS, THEODORE W.	*Wolcott Gibbs Mem. Lab., Cambridge, Mass.*	1899
RIDGWAY, ROBERT.	*U. S. National Museum, Washington, D. C.*	1917
ROSA, EDWARD B.	*Bureau of Standards, Washington, D. C.*	1913
SABINE, WALLACE C.	*Harvard University, Cambridge, Mass.*	1917
SARGENT, CHARLES S.	*Arnold Arboretum, Jamaica Plain, Mass.*	1895
SCHLESINGER, FRANK.	*Allegheny Observatory, Allegheny, Pa.*	1916
SCHUCHERT, CHARLES.	*Yale University, New Haven, Conn.*	1910
SCOTT, WILLIAM B.	*Princeton University, Princeton, N. J.*	1906
SMITH, ALEXANDER.	*Columbia University, New York City.*	1915
SMITH, EDGAR F.	*University of Pennsylvania, Philadelphia, Pa.*	1899
SMITH, ERWIN F.	*Bureau of Plant Industry, Washington, D. C.*	1913
SMITH, THEOBALD.	*Princeton, N. J.*	1908
STIEGLITZ, JULIUS.	*University of Chicago, Chicago, Ill.*	1911
STORY, WILLIAM E.	*Clark University, Worcester, Mass.*	1908
STRATTON, SAMUEL WESLEY.	*Bureau of Standards, Washington, D. C.*	1917
THAXTER, ROLAND.	*Harvard University, Cambridge, Mass.*	1912
THOMSON, ELIHU.	*Swampscott, Mass.*	1907
THORNDYKE, EDWARD LEE.	*Columbia University, New York City.*	1917
TRELEASE, WILLIAM.	*University of Illinois, Urbana, Ill.*	1902
TROWBRIDGE, JOHN.	*Harvard University, Cambridge, Mass.*	1878
ULRICH, EDWARD OSCAR.	*U. S. Geological Survey, Washington, D. C.*	1917
VAN HISE, C. R.	*University of Wisconsin, Madison, Wis.*	1902
VAN VLECK, E. B.	*University of Wisconsin, Madison, Wis.*	1911
VAUGHAN, VICTOR CLARENCE.	*University of Michigan, Ann Arbor, Mich.*	1915
VERRILL, A. E.	*47 Cedar Grove Avenue, New London, Conn.*	1872
WALCOTT, CHARLES D.	*Smithsonian Institution, Washington, D. C.*	1896
WEBSTER, ARTHUR G.	*Clark University, Worcester, Mass.*	1903

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		Date of election.
WELCH, WILLIAM H	*807 St. Paul St., Baltimore, Md.*	1895
WELLS, HORACE L	*Yale University, New Haven, Conn.*	1903
WHEELER, WILLIAM M	*Harvard University, Cambridge, Mass.*	1912
WHITE, DAVID	*U. S. Geological Survey, Washington, D. C.*	1912
WHITE, HENRY SEELY	*Vassar College, Poughkeepsie, N. Y.*	1915
WHITNEY, WILLIS RODNEY	*General Electric Co., Schenectady, N. Y.*	1917
WILLISTON, SAMUEL WENDELL	*University of Chicago, Chicago, Ill.*	1915
WILSON, EDMUND B	*Columbia University, New York City.*	1899
WOOD, HORATIO C	*4107 Chester Avenue, Philadelphia, Pa.*	1879
WOOD, ROBERT W	*Johns Hopkins University, Baltimore, Md.*	1912
WOODWARD, ROBERT S	*Carnegie Institution, Washington, D. C.*	1896

HONORARY MEMBER.

SMITH, SIDNEY I	*Yale University, New Haven, Conn.*	1884

FOREIGN ASSOCIATES.

ARRHENIUS, S. A	*Nobelinstitut, Stockholm.*	1908
BARROIS, CHARLES	*Université, Lille.*	1908
BRØGGER, W. C	*Universitet, Christiania.*	1903
CROOKES, SIR WILLIAM	*London.*	1913
DESLANDRES, HENRI	*Astrophysical Observatory, Meudon.*	1913
DEWAR, SIR JAMES	*University, Cambridge.*	1907
FISCHER, EMIL	*Chemisches Institut der Universität, Berlin.*	1904
FORSYTH, A. R	*Imperial College of Science and Technology, London.*	1907
GEIKIE, SIR ARCHIBALD	*Haslemere, Surrey.*	1901
GROTH, PAUL VON	*Universität, Munich.*	1905
HEIM, ALBERT	*Zürich.*	1913
HILBERT, DAVID	*Universität, Göttingen.*	1907
KAPTEYN, JOHN C	*Rijks Universiteit, Groningen.*	1907
KLEIN, FELIX	*Universität, Göttingen.*	1898
KÖSSEL, ALBRECHT	*Heidelberg.*	1913
KUSTNER, KARL FRIEDRICH	*Bonn.*	1913
LANKESTER, SIR E. RAY	*South Kensington, London.*	1903
LARMOR, SIR JOSEPH	*St. Johns College, Cambridge.*	1908
LORENTZ, HENDRIK ANTON	*Rijks Universiteit, Leiden.*	1906
OSTWALD, WILHELM	*Grossbothen, bei Leipzig.*	1906
PAVLOV, IVAN PETROVITCH	*Inst. for Experimental Medicine, Petrograd.*	1908
PENCK, ALBRECHT	*Universtät, Berlin.*	1909
PFEFFER, WILHELM	*Botanische Institut der Universität, Leipzig.*	1903
PICARD, CHARLES ÉMILE	*Université, Paris.*	1903
RAYLEIGH, LORD	*University, Cambridge.*	1898
RETZIUS, GUSTAV	*Högskolan, Stockholm.*	1909
RUTHERFORD, SIR ERNEST	*University, Manchester.*	1911
SCHUSTER, ARTHUR	*Secretary of the Royal Society, London.*	1913
SEELIGER, HUGO RITTER VON	*Universität, Munich.*	1908
THOMSON, SIR JOSEPH	*University, Cambridge.*	1903
VOLTERRA, VITO	*Università, Rome.*	1911
VRIES, HUGO DE	*Universiteit, Amsterdam.*	1904
WAALS, JOHANNES D. VAN DER	*Amsterdam.*	1913
WALDEYER, WILHELM	*Universität, Berlin.*	1909
WOLF, MAX F. J. C	*Heidelberg.*	1913
WUNDT, WILHELM	*Universität, Leipzig.*	1909

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DECEASED MEMBERS.

	Date of election.	Date of death.
ABBE, CLEVELAND	1878 [1]	Oct. 28, 1916
AGASSIZ, ALEXANDER	1866	Mar. 27, 1910
AGASSIZ, LOUIS	(1)	Dec. 14, 1873
ALEXANDER, J. H.	(1)	Mar. 2, 1867
ALEXANDER, STEPHEN	(1)	June 25, 1883
BACHE, ALEXANDER DALLAS	(1)	Feb. 14, 1867
BAIRD, SPENCER F.	1864	Aug. 19, 1887
BARKER, GEORGE F.	1876 [2]	May 24, 1910
BARNARD, F. A. P.	(1) (2)	Apr. 27, 1889
BARNARD, J. G.	(1)	May 14, 1882
BARTLETT, W. H. C.	(1)	Feb. 11, 1893
BEECHER, CHARLES EMERSON	1899	Feb. 14, 1904
BILLINGS, JOHN S.	1883	Mar. 11, 1913
BOSS, LEWIS	1889 [2]	Oct. 5, 1912
BOWDITCH, HENRY P.	1887 [2]	Mar. 13, 1911
BREWER, WILLIAM H.	1880 [2]	Nov. 2, 1910
BROOKS, WILLIAM KEITH	1884	Nov. 12, 1908
BROWN-SEQUARD, CHARLES E.	1868	Apr. 2, 1894
BRUSH, GEORGE JARVIS	1868 [2]	Feb. 6, 1912
CASEY, THOMAS L.	1890	Mar. 25, 1896
CASWELL, ALEXIS	(1)	Jan. 8, 1877
CHANDLER, SETH CARLO	1888 [2]	Dec. 31, 1913
CHAUVENET, WILLIAM	(1)	Dec. 13, 1870
CLARK, HENRY JAMES	1872	July 1, 1873
CLARK, WILLIAM B.	1908 [2]	July 27,, 1917
COFFIN, JAMES H.	1869	Feb. 6, 1873
COFFIN, J. H. C.	(1)	Jan. 8, 1890
COMSTOCK, CYRUS B.	1884	May 29, 1910
COOK, GEORGE H.	1887	Sept. 22, 1889
COOKE, JOSIAH P.	1872	Sept. 3, 1894
COPE, EDWARD D.	1872 [2]	Apr. 12, 1897
COUES, ELLIOTT	1877	Dec. 25, 1899
CRAFTS, JAMES M.	1872 [2]	June 21, 1917
DALTON, J. C.	1864	Feb. 2, 1889
DANA, JAMES D.	(1) (2)	Apr. 14, 1895
DAVIDSON, GEORGE	1874 [2]	Dec. 2, 1911
DAVIS, CHARLES H.	(1)	Feb. 18, 1877
DRAPER, HENRY	1877	Nov. 20, 1882
DRAPER, JOHN W.	1877	Jan. 4, 1882
DUTTON, C. E.	1884 [2]	Jan. 4, 1912
EADS, JAMES B.	1872	Mar. 8, 1887
EMMONS, SAMUEL F.	1892	Mar. 28, 1911
ENGLEMANN, GEORGE	(1)	Feb. 4, 1884
FERREL, WILLIAM	1868	Sept. 18, 1891
FRASER, JOHN FRIES	(1)	Oct. 12, 1872
GABB, WILLIAM M.	1876	May 30, 1878
GENTH, F. A.	1872	Feb. 2, 1893
GIBBS, JOSIAH WILLARD	1879	Apr. 28, 1903
GIBBS, WOLCOTT	(1)	Dec. 9, 1908
GILL, THEODORE NICHOLAS	1873	Sept. 25, 1914
GILLISS, JAMES MELVILLE	(1)	Feb. 9, 1865
GOODE, G. BROWN	1888	Sept. 6, 1896
GOULD, AUGUSTUS A.	(1)	Sept. 15, 1866
GOULD, BENJAMIN A.	(1) (2)	Nov. 26, 1896

[1] Charter members, Mar. 3, 1863. [2] Biographical notices have not been presented.

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Deceased members—Continued.

	Date of election.	Date of death.
GRAY, ASA	(1)	Jan. 30, 1888
GUYOT, ARNOLD	(1)	Feb. 8, 1884
HADLEY, JAMES	1872	Nov. 14, 1872
HAGUE, ARNOLD	1885 [2]	May 15, 1917
HALDEMAN, S. S	1876	Sept. 20, 1880
HALL, ASAPH	1875	Nov. 22, 1907
HALL, JAMES	(1) (3)	Aug. 7, 1898
HAYDEN, F. V	1873	Dec. 22, 1887
HENRY, JOSEPH	(1)	May 13, 1878
HILGARD, EUGENE W	1872 [2]	Jan. 8, 1916
HILGARD, JULIUS E	(1)	May 9, 1890
HILL, GEORGE WILLIAM	1874	Apr. 16, 1914
HILL, HENRY B	1883	Apr. 6, 1903
HITCHCOCK, EDWARD	(1)	Feb. 27, 1864
HOLBROOK, J. E	1868	Sept. 8, 1871
HOLDEN, EDWARD SINGLETON	1885	Mar. 16, 1914
HUBBARD, J. S	(1)	Aug. 16, 1863
HUMPHREYS, A. A	(1)	Dec. 27, 1883
HUNT T. STERY	1873 [2]	Feb. 12. 1892
HYATT, ALPHEUS	1875	Jan. 15, 1902
JAMES, WILLIAM [2]	1903	Aug. 26, 1910
JOHNSON, S. W	1866	July 21, 1909
KEELER, J. E	1900	Aug. 12, 1900
KING, CLARENCE	1876	Dec. 24, 1901
KIRTLAND, JARED P	1865	Dec. 10, 1877
LANE, J. HOMER	1872	May 3, 1880
LANGLEY, SAMUEL P	1876	Feb. 27, 1906
LEA, MATTHEW CAREY	1892	Mar. 15, 1897
LE CONTE, JOHN	1878	Apr. 29, 1891
LE CONTE, JOHN L	(1)	Nov. 15, 1883
LE CONTE, JOSEPH	1875	July 6, 1901
LEIDY, JOSEPH	(1)	Apr. 30, 1891
LESLEY, J. PETER	(1)	June 1, 1903
LESQUEREUX, LEO	1864	Oct. 20, 1889
LONGSTRETH, MIERS F	(1)	Dec. 27, 1891
LOOMIS, ELIAS	1873	Aug. 15, 1889
LOVERING, JOSEPH	1873	Jan. 18, 1892
LYMAN, THEODORE	1872	Sept. 9, 1897
MAHAN, D. H	(1)	Sept. 16, 1871
MALL, FRANKLIN P	1907 [2]	Nov. 17, 1917
MARSH, G. P	1866	July 23, 1882
MARSH, O. C	1874 [2]	Mar. 18, 1899
MAYER, ALFRED M	1872	July 13, 1897
MAYO-SMITH, RICHMOND	1890 [2]	Nov. 11, 1901
MEEK, F. B	1869	Dec. 21, 1876
MEIGS, M. C	1865	Jan. 2, 1892
MINOT, CHARLES SEDGWICK	1897 [2]	Nov. 19, 1914
MITCHELL, HENRY	1885 [2]	Dec. 1, 1902
MITCHELL, SILAS WEIR	1865 [2]	Jan. 4, 1914
MORGAN, LEWIS H	1875	Dec. 17, 1881
MORTON, HENRY	1874	May 9, 1902
NEF, JOHN ULRIC	1904 [2]	Aug. 13, 1915
NEWBERRY, J. S	(1)	Dec. 7, 1892
NEWCOMB, SIMON	1869 [2]	July 11, 1909

[1] Charter members, Mar. 3, 1863.

[2] Biographical notices have not been presented.

[3] Resigned in 1908 or 1909.

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Deceased members—Continued.

	Date of election.	Date of death.
NEWTON, H. A.	(1)	Aug. 12, 1896
NEWTON, JOHN	1876	May 1, 1895
NORTON, WILLIAM A	1873	Sept. 21, 1883
OLIVER, JAMES E	1872	Mar. 27, 1895
PACKARD, A. S	1872 [2]	Feb. 14, 1905
PENFIELD, SAMUEL L	1900	Aug. 13, 1906
PETERS, C. H. F	1876 [2]	July 18, 1890
PIERCE, BENJAMIN [3]	(1) ([3])	Oct. 6, 1880
PIERCE, BENJAMIN OSGOOD	1906 [2]	Jan. 14, 1914
PIERCE, CHARLES SANTIAGO SANDERS	1876 [2]	Apr. 20, 1914
POURTALES, L. F	1873	July 19, 1880
POWELL, JOHN W	1880	Sept. 23, 1902
PUTNAM, FREDERICK W	1885 [2]	Aug. 18, 1915
RODGERS, JOHN	(1)	May 5, 1882
ROGERS, FAIRMAN	(1)	Aug. 22, 1900
ROGERS, ROBERT E [4]	(1)	Sept. 6, 1884
ROGERS, WILLIAM A	1885	Mar. 1, 1898
ROGERS, WILLIAM B [5]	(1)	May 30, 1882
ROOD, OGDEN N	1865	Nov. 12, 1902
ROWLAND, HENRY A	1881	Apr. 16, 1901
ROYCE, JOSIAH	1906 [2]	Sept. 14, 1916
RUTHERFURD, LEWIS M	(1)	May 30, 1892
SAXTON, JOSEPH	(1)	Oct. 26, 1873
SCHOTT, CHARLES A	1872	July 31, 1901
SCUDDER, SAMUEL H	1877 [2]	May 17, 1911
SELLERS, WILLIAM	1873 [2]	Jan. 24, 1905
SILLIMAN, BENJ., Sr	(1)	Nov. 24, 1864
SILLIMAN, BENJ., Jr	(1)	Jan. 14, 1885
SMITH, J. LAWRENCE	1872	Oct. 12, 1883
STIMPSON, WILLIAM	1868 [2]	May 26, 1872
STRONG, THEODORE	(1)	Feb. 1, 1869
SULLIVANT, W. S	1872	Apr. 30, 1873
TORREY, JOHN	(1)	Mar. 10, 1873
TOTTEN, J. G	(1)	Apr. 22, 1864
TROWBRIDGE, WILLIAM P	1872	Aug. 12, 1892
TRUMBULL, JAMES H	1872	Aug. 5, 1897
TUCKERMAN, EDWARD	1868	Mar. 15, 1886
WALKER, FRANCIS A	1878	Jan. 5, 1897
WARREN, G. K	1876	Aug. 8, 1882
WATSON, JAMES C	1868	Nov. 23, 1880
WATSON, SERENO	1889	Mar. 9, 1892
WHEELER, HENRY LORD	1909 [2]	Oct. 30, 1914
WHITE, CHARLES A	1889	June 29, 1910
WHITMAN, C. O	1895	Dec. 6, 1910
WHITNEY, JOSIAH D [6]	(1) ([6])	Aug. 19, 1896
WHITNEY, WILLIAM D [6]	1865 [2]	June 29, 1894
WINLOCK, JOSEPH	(1)	June 11, 1875
WOODWARD, J. J	1873	Aug. 17, 1884
WORTHEN, A. H	1872	May 6, 1888
WRIGHT, ARTHUR WILLIAMS	1881 [2]	Dec. 19, 1915
WYMAN, JEFFRIES	(1)	Sept. 4, 1874
YOUNG, CHARLES A	1872	Jan. 3, 1908

[1] Charter members, Mar. 3, 1863.
[2] Biographical notices have not been presented.
[3] Resigned 1873.
[4] Dropped —, reelected 1875.
[5] Dropped —, reelected 1872.
[6] Resigned.

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DECEASED FOREIGN ASSOCIATES.

ADAMS, J. C.
AIRY, SIR GEORGE B.
ARGELANDER, F. W. A.
AUWERS, G. F. J. ARTHUR
BACKLUND, OSKAR
BAER, KARL ERNEST VON
BAEYER, ADOLF VON.
BARRANDE, JOACHIM
BEAUMONT, L. ÉLIE DE
BECQUEREL, HENRI
BERTHELOT, M. P. E.
BERTRAND, J. L. F.
BOLTZMANN, LUDWIG
BORNET, EDOUARD
BOUSSINGAULT, J. B. J. D.
BOVERI, THEODOR
BRAUN, ALEXANDER
BREWSTER, SIR DAVID
BUNSEN, ROBERT W.
BURMEISTER, C. H. C.
CANDOLLE, ALPHONSE DE
CAYLEY, ARTHUR
CHASLES, MICHEL
CHEVREUL, M. E.
CLAUSIUS, RUDOLPH
CORNU, ALFRED
DARBOUX, GASTON
DARWIN, SIR GEORGE HOWARD
DOVE, H. W.
DUMAS, J. B.
EHRLICH, PAUL
FARADAY, MICHAEL
GEGENBAUR, KARL
GLYDÉN, HUGO
GILL, SIR DAVID
HAMILTON, SIR WILLIAM ROWAN
HELMHOLTZ, BARON H. VON
HOFF, J. H. VAN'T
HOFMANN, A. W.
HOOKER, SIR JOSEPH D.
HUGGINS, SIR WILLIAM
HUXLEY, T. H.
IBAÑEZ, CARLOS
JANSSEN, J.
JOULE, JAMES P.
KEKULÉ, AUGUST
KELVIN, LORD
KIRCHOFF, G. R.
KOCH, ROBERT
KOHLRAUSCH, FRIEDRICH
KÖLLIKER, ALBERT VON
KRONECKER, HUGO
LACAZE-DUTHIERS, HENRI DE
LEUCKART, RUDOLPH
LIE, SOPHUS
LIEBIG, JUSTUS VON
LISTER, LORD
LOEWY, MAURICE
LUDWIG, K. F. W.
MAREY, E. J.
MENDELÉEFF, D. I.
MILNE-EDWARDS, HENRI
MOISSAN, HENRI
MURCHISON, SIR RODERICK I.
MURRAY, SIR JOHN
OPPOLZER, THEODORE VON
OWEN, SIR RICHARD
PASTEUR, LOUIS
PETERS, C. A. F.
PLANA, G. A. A.
POINCARÉ, JULES HENRI
RAMMELSBERG, C. F.
RAMSAY, SIR WILLIAM
REGNAULT, VICTOR
REYMOND, EMIL DU BOIS
RICHTHOFEN, F. VON
ROSENBUSCH, KARL HARRY FERDINAND
SACHS, JULIUS VON
SCHIAPARELLI, GIOVANNI
STAS, JEAN SERVAIS
STOKES, SIR GEORGE G.
STRASBURGER, EDOUARD
STRUVE, OTTO VON
SUESS, EDUARD
SYLVESTER, J. J.
TISSERAND, F. F.
VIRCHOW, RUDOLPH VON
VOGEL, H. C.
WEIERSTRASS, KARL
WEISMANN, AUGUST
WÖHLER, FRIEDRICH
WÜRTZ, ADOLPH
ZIRKEL, FERDINAND
ZITTELL, K. A R. VON

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REPORT

OF THE

NATIONAL ACADEMY OF SCIENCES

FOR THE YEAR

1918

WASHINGTON
GOVERNMENT PRINTING OFFICE
1919

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REPORT

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1918

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CONTENTS.

	Page.
Letter of transmittal	5
Act of incorporation	6
Amendments	7
Meetings of the National Academy, 1918	9
Annual meeting	9
Members in attendance	9
Business sessions	9
Announcement by the President	9
Reports from officers of the academy	10
Report of the treasurer	11
Report of the home secretary	11
Report of the directors of the Bache fund	12
Report of the trustees of the Watson fund	13
Report of the committee on the Henry Draper fund	13
Report of the committee on the J. Lawrence Smith fund	15
Report of the directors of the Wolcott Gibbs fund	17
Report of the Comstock fund	18
Report of the committee on the Murray fund	19
Report of commission on the Marsh fund	19
Report of the editorial board of the proceedings	19
Report of the finance committee of proceedings	21
Award of medals	21
Election of officers and members	21
Scientific sessions	22
April 22	22
April 23	23
Autumn meeting	24
Members in attendance	24
Business sessions	24
Announcement of deaths	24
Biographical memoirs	24
Changes in editorial board of the proceedings	24
Resignation of home secretary	25
National Research Council, Executive order	25
National Research Council funds	26
London conference	26
Auditing committee	27
League of nations	27
Scientific sessions	27
November 18	27
November 19	28
Deceased members—	
Grove Karl Gilbert	28
Samuel Wendell Williston	34
Report of the National Research Council	39
The President's Executive order	39
Research information service	41
Organization of the International Research Council	50
Report of the patent committee	58
Promotion of industrial research	60
Financial support	61
Permanent organization	62
Reports of divisions	63
Division of general relations	63
Military division	66

Digitized by Google

Report of the National Research Council—Continued.
Reports of divisions—Continued. Page.
Division of physical sciences ... 69
Engineering division ... 75
Section on metallurgy ... 75
Section on mechanical engineering ... 77
Section on electrical engineering ... 79
Section on prime movers ... 79
Division of chemistry and chemical technology ... 80
Activities of the committees of the division ... 81
Committee on explosives investigations ... 83
Committee on nitrate investigations ... 84
Division of geology and geography ... 86
General activities of the division ... 86
Cooperation with Government bureaus and other organizations ... 87
Division of medicine and related sciences ... 88
Division of biology ... 95
Publications ... 98
Acknowledgment ... 98
Report of the treasurer ... 98
War organization ... 101
Division of general relations ... 102
Military division ... 102
Research Information Service ... 103
Division of engineering ... 104
Division of physics, mathematics, astronomy, and geophysics ... 105
Division of chemistry and chemical technology ... 105
Division of geology and geography ... 107
Division of medicine and related sciences ... 107
Division of agriculture, botany, forestry, zoology, fisheries ... 108
Organization of the National Research Council ... 109
Annual report of the treasurer ... 113
General review of financial transactions ... 113
Trust funds of the academy ... 114
Statement of assets and liabilities ... 115
Condensed statement of receipts and expenditures ... 118
Accounts with individual funds ... 120
Report of auditing committee ... 126
Appendixes ... 128
Appendix A—Constitution of the National Academy ... 129
Appendix B—Rules ... 136
Appendix C—Organization of the academy, 1918-19 ... 142
Sections ... 142
Standing committees ... 143
Trust funds ... 144
Members of the National Academy of Sciences, December 31, 1918 ... 146
Honorary member ... 149
Foreign associates ... 149
Deceased members ... 150
Deceased foreign associates ... 153

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LETTER OF TRANSMITTAL.

NATIONAL ACADEMY OF SCIENCES,
February 6, 1919.

The honorable THOMAS R. MARSHALL,
Vice President of the United States,
Washington, D. C.

SIR: I have the honor to transmit to you herewith the annual report of the president of the National Academy of Sciences for the year ending December 31, 1918.

Very respectfully,

CHARLES D. WALCOTT,
President.

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ACT OF INCORPORATION.

AN ACT To incorporate the National Academy of Sciences.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That Louis Agassiz, Massachusetts; J. H. Alexander, Maryland; S. Alexander, New Jersey; A. D. Bache, at large; F. B. Barnard,[1] at large; J. G. Barnard, United States Army, Massachusetts; W. H. C. Bartlett, United States Military Academy, Missouri; U. A. Boyden,[2] Massachusetts; Alexis Caswell, Rhode Island; William Chauvenet, Missouri; J. H. C. Coffin, United States Naval Academy, Maine; J. A. Dahlgren,[2] United States Navy, Pennsylvania; J. D. Dana, Connecticut; Charles H. Davis, United States Navy, Massachusetts; George Englemann, Saint Louis, Missouri; J. F. Frazer, Pennsylvania; Wolcott Gibbs, New York; J. M. Gilless,[3] United States Navy, District of Columbia; A. A. Gould, Massachusetts; B. A. Gould, Massachusetts; Asa Gray, Massachusetts; A. Guyot, New Jersey; James Hall, New York; Joseph Henry, at large; J. E. Hilgard, at large, Illinois; Edward Hitchcock, Massachusetts; J. S. Hubbard, United States Naval Observatory, Connecticut; A. A. Humphreys, United States Army, Pennsylvania; J. L. Le Conte, United States Army, Pennsylvania; J. Leidy, Pennsylvania; J. P. Lesley, Pennsylvania; M. F. Longstreth, Pennsylvania; D. H. Mahan, United States Military Academy, Virginia; J. S. Newberry, Ohio; H. A. Newton, Connecticut; Benjamin Peirce, Massachusetts; John Rodgers, United States Navy, Indiana; Fairman Rogers, Pennsylvania; R. E. Rogers, Pennsylvania; W. B. Rogers, Massachusetts; L. M. Rutherford, New York; Joseph Saxton, at large; Benjamin Silliman, Connecticut; Benjamin Silliman, junior, Connecticut; Theodore Strong, New Jersey; John Torrey, New York; J. G. Totten, United States Army, Connecticut; Joseph Winlock, United States Nautical Almanac, Kentucky; Jeffries Wyman, Massachusetts; J. D. Whitney, California; their associates and uccessors duly chosen, are hereby incorporated, constituted, and declared to be a body corporate, by the name of the National Academy of Sciences.

SEC. 2. *And be it further enacted*, That the National Academy of Sciences shall consist of not more than fifty ordinary members, and

[1] The official list of members gives the name of F. A. P. Barnard.
[2] Declined.
[3] The official list of members gives the name of J. M. Gillis.

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the said corporation hereby constituted shall have power to make its own organization, including its constitution, by-laws, and rules and regulations; to fill all vacancies created by death, resignation, or otherwise; to provide for the election of foreign and domestic members, the division into classes, and all other matters needful or usual in such institution, and to report the same to Congress.

SEC. 3. *And be it further enacted*, That the National Academy of Sciences shall hold an annual meeting at such place in the United States as may be designated, and the academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art, the actual expense of such investigations, examinations, experiments, and reports to be paid from appropriations which may be made for the purpose, but the academy shall receive no compensation whatever for any services to the Government of the United States.

SOLOMON FOOTE,
President of the Senate pro tempore.
GALUSHA A. GROW,
Speaker of the House of Representatives.

Approved, March 3, 1863.
ABRAHAM LINCOLN, *President.*

AMENDMENTS.

AN ACT To amend the act to incorporate the National Academy of Sciences.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the act to incorporate the National Academy of Sciences, approved March third, eighteen hundred and sixty-three, be, and the same is hereby, so amended as to remove the limitation of the number of ordinary members of said academy as provided in said act.

Approved, July 14, 1870.

AN ACT To authorize the National Academy of Sciences to receive and hold trust funds for the promotion of science, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the National Academy of Sciences, incorporated by the act of Congress, approved March third, eighteen hundred and sixty-three, and its several supplements, be, and the same is hereby, authorized and empowered to receive bequests and donations and hold the same in trust, to be applied by the said academy in aid of scientific investigations and according to the will of the donors.

Approved, June 20, 1884.

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AN ACT To amend the act authorizing the National Academy of Sciences to receive and hold trust funds for the promotion of science, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the act to authorize the National Academy of Sciences to receive and hold trust funds for the promotion of science, and for other purposes, approved June twentieth, eighteen hundred and eighty-four, be, and the same is hereby, amended to read as follows:

"That the National Academy of Sciences, incorporated by the act of Congress approved March third, eighteen hundred and sixty-three, be, and the same is hereby, authorized and empowered to receive, by devise, bequest, donation, or otherwise, either real or personal property, and to hold the same absolutely or in trust, and to invest, reinvest, and manage the same in accordance with the provisions of its constitution, and to apply said property and the income arising therefrom to the objects of its creation and according to the instructions of the donors: *Provided, however*, That the Congress may at any time limit the amount of real estate which may be acquired and the length of time the same may be held by said National Academy of Sciences."

SEC. 2. That the right to alter, amend, or repeal this act is hereby expressly reserved.

Approved, May 27, 1914.

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ANNUAL REPORT

OF THE

NATIONAL ACADEMY OF SCIENCES.

MEETINGS OF THE NATIONAL ACADEMY.

During the year 1918 the academy held two stated meetings, the annual meeting in April, at Washington, and the autumn meeting in November, at Baltimore, Md.

ANNUAL MEETING.

The annual meeting of the academy was held in the Smithsonian Institution in Washington, April 22, 23, and 24, 1918.

Fifty-eight members were present, as follows:

Abbot, C. G.
Ames, J. S.
Bailey, L. H.
Becker, G. F.
Benedict, F. G.
Campbell, W. W.
Carty, J. J.
Clarke, F. W.
Clarke, J. M.
Conklin, E. G.
Crew, Henry
Cross, Whitman
Dall, W. H.
Davenport, C. B.
Davis, W. M.
Donaldson, H. H.
Fewkes, J. W.
Flexner, Simon
Hale, G. E.
Halsted, W. S.
Hillebrand, W. F.
Howard, L. O.
Howell, W. H.
Iddings, J. P.
Kasner, Edward
Lillie, F. R.
Meltzer, S. J.
Mendel, L. B.
Mendenhall, T. C.
Merriam, C. H.
Michelson, A. A.
Millikan, R. A.
Morse, E. S.
Moulton, F. R.
Nichols, E. L.
Nichols, E. F.
Noyes, A. A.
Noyes, W. A.
Osborn, H. F.
Pearl, Raymond
Pupin, M. I.
Ransome, F. L.
Reid, H. F.
Rosa, E. B.
Schlesinger, Frank
Smith, Erwin F.
Stratton, S. W.
Thomson, Elihu
Ulrich, E. O.
Van Hise, C. R.
Van Vleck, E. B.
Walcott, C. D.
Webster, A. G.
Welch, W. H.
Wheeler, W. M.
White, David
Wilson, E. B.
Woodward, R. S.

BUSINESS SESSIONS.

ANNOUNCEMENT BY THE PRESIDENT.

The president announced that the home secretary, Mr. Arthur L. Day, would not be present, owing to absence from the city on matters relating to the war.

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REPORTS FROM OFFICERS OF THE ACADEMY.

The annual report of the president to Congress for 1917 was presented and distributed.

The president presented the following communication from Mr. R. S. Woodward, resigning the chairmanship of the committee on the Barnard medal:

WASHINGTON, D. C., *April 9, 1918.*

The HOME SECRETARY NATIONAL ACADEMY OF SCIENCES,
Smithsonian Institution, Washington, D. C.

DEAR SIR: Permit me to tender through your office to the council of the National Academy of Sciences my resignation as chairman of the committee on the Barnard medal. Like our late colleague, Prof. William James, I find that with advancing years it is desirable to relieve oneself of what he fittingly called "life's baggage." Having assisted at the birth of many of our American societies and served them in one way or another for many years. and having acted as the chairman of the committee on the Barnard medal for a decade, I am disposed to think it will be advantageous for me, for the academy, and for contemporary society to transfer the duties of the chairmanship of the committee in question to a younger man.

Faithfully, yours,

ROBERT S. WOODWARD.

The resignation of Mr. Robert S. Woodward as chairman of the committee on the Barnard medal was accepted with regret, Mr. T. H. Morgan was elected a member of the committee, and Mr. A. A. Noyes was elected chairman.

The president presented the following recommendations from the council:

That the Henry Draper medal be awarded to Walter Sidney Adams, Mount Wilson Observatory, for his investigations in astrophysics.

That the Daniel Giraud Elliot medal and honorarium be awarded to Dr. Frank M. Chapman, of the American Museum of Natural History, for having produced during the year 1917 his memoir, "The Distribution of Bird Life in Colombia, a Contribution to a Biological Survey of South America," Bulletin of the American Museum of Natural History, Volume XXXVI, pages vii–x, 1–729.

The award of the Henry Draper medal to Walter Sidney Adams and the Daniel Giraud Elliot medal and honorarium to Dr. Chapman were approved by the Academy.

The president announced the following changes in the personnel of the sections and committees:

Section of geology and paleontology.—J. M. Clarke, chairman.

Section of botany.—Erwin F. Smith, chairman.

Section of anthropology and psychology.—J. Walter Fewkes, acting chairman.

Local committee.—Whitman Cross (chairman), David White, Frederick L. Ransome, Raymond Pearl, Edward O. Ulrich.

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Committee on program.—E. L. Thorndike to serve unexpired term of J. McKeen Cattell, 1919.

Committee on the Henry Draper fund.—George E. Hale to succeed himself, term expiring 1923.

Committee on the J. Lawrence Smith fund.—E. S. Dana to succeed himself, term expiring 1923.

Committee on the Comstock fund.—E. L. Nichols to succeed himself as member and chairman, term expiring 1923.

Committee on the Marsh fund.—Charles Schuchert to succeed himself, term expiring 1921.

Committee on the Murray fund.—William H. Dall to succeed himself as member and chairman, term expiring 1921.

Committee on the Marcellus Hartley fund.—Henry F. Osborn and Michael I. Pupin to succeed themselves, terms expiring 1921.

REPORT OF THE TREASURER.

The report of the treasurer was presented in printed form and approved.

REPORT OF THE HOME SECRETARY.

APRIL 22, 1918.

The PRESIDENT OF THE NATIONAL ACADEMY OF SCIENCES,
Washington, D. C.

SIR: I have the honor to present the following report on the publications and membership of the National Academy of Sciences for the year ending April 24, 1918.

No scientific memoirs have been published during the year, but The Complete Classification of the Triad Systems in Fifteen Elements, by H. S. White, F. N. Cole, and Miss L. D. Cummins, recommended to be published as one of the memoirs of the National Academy of Sciences, was approved by the committee on publication and is now in the hands of the Public Printer. The actual publication may be delayed, owing to war conditions.

Of the biographical memoirs, that of John Shaw Billings, by S. Wier Mitchell, with the Scientific Work of John Shaw Billings, by Fielding H. Garrison, and of William Stimpson, by Alfred G. Mayer, have been published. The former has been distributed, while that of Stimpson has just come from the printer. The manuscript of the Biographical Memoir of James Dwight Dana, by L. V. Pirsson; Cleveland Abbe, by W. J. Humphreys; and William Bullock Clark, by John M. Clarke, are in the hands of the committee on printing; that of Benjamin O. Peirce, by Edwin H. Hall, is now in galley proof.

The Annual Report for 1917 has been published and is ready for distribution. The Proceedings of the Academy have been published regularly and have reached the third number of the fourth volume.

Four members have died since the last meeting. William Bullock Clark, elected in 1908, died July 27, 1917; James M. Crafts, elected in 1872, died June 21, 1917; Arnold Hague, elected in 1885, died May 15, 1917; Franklin Paine Mall, elected in 1907, died November 17, 1917, and one foreign associate. Adolf von Baeyer, died in August, 1917.

Fifteen new members were elected in April, 1917, making 157 active members on the present membership list, one honorary member, and 36 foreign associates.

ARTHUR L. DAY, *Home Secretary.*

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REPORT OF THE DIRECTORS OF THE BACHE FUND.

Since the annual meeting of the Academy in April, 1917, the following grants have been made:

No. 205, T. H. Goodspeed, University of California, $100. For studies of inheritance in Nicotiana hybrids.

No. 206, Reginald A. Daly, Harvard University, $700. For the completion of the deep-sea thermograph designed and partly constructed under grant No. 194. (In continuation of No. 194.)

No. 207, T. H. Gronwall, New York City, $300. To complete and extend mathematical researches on conformal representation.

No. 208, A. Franklin Shull, University of Michigan, $400. To investigate the cause of sex production and the life cycle of rotifers, together with artificial modification of life cycle; differential factors in fertilization of male-producing and female-producing rotifers; sex determination and the life cycle of the thrips; cause of sex production, wing production, and other cyclical phenomena in aphids.

No. 209, Cecil K. Drinker, Harvard Medical School, $350. For the closer study of the factors involved in extension of unchecked red cells and leucocytes in the dog.

No. 204. Irving W. Bailey, Bussey Institute. For field data for a study of environment upon the anatomical structure of angiosperms has been canceled and the money returned to the Treasurer because it was found impracticable for Prof. Bailey to go to Guatemala under present war conditions.

Reports of previous grants have been received as follows:

No. 193, C. A. Kofoid, University of California. For assistance in securing animals in the Indian jungle and in their preparation for study in research on the intestinal protozoa. Mr. Kofoid is serving as major in the Sanitary Corps and the work is being continued by research assistants on the material collected during Mr. Kofoid's travels.

No. 202, W. C. Allee, Lake Forest College, Ill. Research concluded on "The salt content of natural waters in relation to rheotaxis in Asellus," Biological Bulletin 32, 93–97. Preliminary results on first phase of investigation concerning a possible correlation between CO_2 production and phototaxis are completed and are in the hands of the editors of the Journal of Experimental Zoology. Research is in progress concerning the cause of formation of aggregations of may-fly nymphs and other reactions, and to CO_2 production. Also effect of molting on both above factors; also as to effect of the cyanides on respiration and reactions to various stimuli.

No. 203, J. P. Iddings, Brinklow, Md. The chemical analysis of igneous rocks collected in Asia and Australasia is completed and the results published in the Proceedings of this Academy. The work with the microscope and thin sections will continue for some years to come.

No. 205, T. H. Goodspeed, University of California. Between 20,000 and 25,000 measurements in the flower-size investigations on Nocotiana were made during the summer and fall of 1917. These experiments are to be concluded during the summer and results published thereafter.

No. 206, Reginald A. Daly, Harvard University. The deep-sea thermograph has been completed and a description has been published by its designer, Mr. Harry A. Clark, in the Bulletin of the Museum of Comparative Zoology at Harvard College, Volume LXI, No. 15.

No. 209. Cecil K. Drinker, Harvard Medical School. Research still in progress. A paper, entitled "The factors concerned in the appearance of nucleated red-blood corpuscles in the peripheral blood. II. Influence of procedures de-

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signed to increase the rate of blood flow through the blood-forming organs—hemorrhage and infusion," by Cecil K. Drinker, Katharine R. Drinker, and Henry A. Kreutzmann, was published in the Journal of Experimental Medicine, Volume XXVII, 383–397, 1918.

The directors have voted to transfer to capital account the sum of $2,575, which has been carried for a number of years as "invested income," together with $425 of current income, so that the principal of the fund now stands at $59,000.

An effort is being made to pay the American collaborators of the Nomenclator Animalium Generum et Subgenerum the amounts due them for their work. A grant of $1,000 was made in 1913 to Prof. F. E. Schulze, of Berlin, specifically for assistance by American men of science in this undertaking. It now seems probable that these men can soon receive their compensation. After providing for this liability of $1,000, the cash on hand available for grants on April 15, 1918, is $10.81.

E. B. Frost, *Chairman.*

REPORT OF THE TRUSTEES OF THE WATSON FUND.

At the annual meeting for 1917 a grant of $500 was voted to Prof. John A. Miller, director of the Sproul Observatory of Swarthmore College, Swarthmore, Pa., and a grant of $325 was voted to Prof. Herbert C. Wilson, of Carleton College, Northfield, Minn. The reports of the results achieved with the aid of these grants are essentially as follows:

Prof. Wilson is expending the appropriation for the services of an assistant in measuring and reducing photographic plates of asteroids for position and magnitude. The measurement and reduction of 97 plates has been completed. For 71, the results are published in Publications of Goodsell Observatory, No. 5. Of the 26 unpublished measures, 15 are of plates of seven Watson asteroids.

Mr. R. J. Wallace, director of the research laboratories of the Cramer Dry Plate Co., has made a color screen suitable for the 16-inch telescope, which has been highly satisfactory.

Prof. Miller is expending his appropriation for the services of an assistant in parallax determinations. A list of 50 parallaxes, together with a list of observations and reductions, has been published. A second list of 50 should be ready before the beginning of January, 1919.

The following vote is recommended:

Resolved, That $300 be appropriated for a continuance of the work conducted by Prof. Herbert C. Wilson, consisting of the determination of the position and brightness of asteroids (chiefly those discovered by Watson) by the photographic method, together with a study of the brightness of some variable stars.

Resolved, That the appropriation of $500 to Prof. John A. Miller be renewed for the year beginning July 1, 1918.

The available income of the Watson fund on April 1, 1918, was $1,590.57.

A. O. Leuschner, *Chairman.*
W. L. Elkins.
George C. Comstock.

The report was adopted and appropriations authorized.

REPORT OF THE COMMITTEE ON THE HENRY DRAPER FUND.

No awards have been made in the past year; the reduced size of many observatory and laboratory staffs because of war activities has not permitted

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normal development of new methods in astrophysics, and there have been no urgent calls for special instruments.

A grant of $500 made to W. W. Campbell two years ago, to provide the mounting of an ultra-violet spectograph for use with the Crossley reflecting telescope, was expended, and the finished instrument was described in Lick Observatory Bulletin, No. 291, in May, 1917. This instrument has been used by Mr. Wright in photographing the spectra of all the brighter planetary nebulae in the northern two-thirds of the sky.

A grant of $300 made in April, 1917, to Prof. Joel Stebbins, of the University of Illinois, and a similar grant in like amount made earlier, are being applied, in accordance with agreement, in payment of part-time salary of an assistant to Dr. Stebbins in order to further the latter's development of the photo-electric cell photometer and the application to the study of variable stars. Quoting from Prof. Stebbins's report dated April, 1918:

"The photo-electric photometer has been improved until it is now from 10 to 20 times as sensitive as the selenium photometer. We can measure the brightness of stars three magnitudes fainter than those which it was possible to observe with the selenium instrument. About a dozen new bright variable stars have been discovered, of which eight have been announced at meetings of the American Astronomical Society. We are also carrying on studies of several known variables."

In further agreement with the terms of the grant, the University of Illinois has arranged to continue the assistant on full time in Prof. Stebbins's department after the close of the present academic year.

Respectfully submitted.

W. W. CAMPBELL, *Chairman.*

The report was accepted.

REASONS FOR THE AWARD OF THE HENRY DRAPER GOLD MEDAL OF THE NATIONAL ACADEMY OF SCIENCES TO DR. WALTER SIDNEY ADAMS.

Dr. Adams has discovered and developed a method of determining the distances of the stars, by means of the spectrograph, which the Henry Draper committee believes is one of the great advances in modern astronomy. Like most methods of high value, its fundamentals are exceedingly simple. The basic fact is that certain lines are enhanced in the spectra of stars of high absolute luminosity, and certain other lines are enhanced in the spectra of stars of low absolute luminosity; in other words, the intensities of certain lines increase continuously with increasing absolute luminosities, and the intensities of certain other lines increase continuously with decreasing absolute luminosities. The approximate distances of a few hundred of the nearer stars, measured by the older methods, are known. These distances enable us to compute the absolute magnitudes or luminosities of those stars. The correlation of these absolute magnitudes and the estimated relative intensities of the critical lines in their spectra have given Mr. Adams the power to determine the functional relations connecting these elements, and thus to determine the absolute magnitudes of stars not yet observed for distance. Knowing the magnitude of a star as observed from the earth and the absolute magnitude of the same star as determined by the spectrograph, the solution of a simple equation yields at once the value of the star's distance. Here is a powerful means of extending the list of stars whose distances are known, and the committee confidently expects that the method will be applied successfully to thousands of stars which are too distant for successful attack by the earlier methods. The

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method should in due time tell us much concerning the linear scale of the nearer parts of our stellar system. The secondary applications of the method to astronomical problems are likewise of great promise.

Mr. Adams has applied the spectrographic method to the determination of the distances of more than 500 stars, of the Harvard spectral classes, F to Mb, inclusive, and a comparison of his results with those obtained by the older methods as to rapidity and accuracy is a subject for congratulation.

The method has not yet been applied satisfactorily to stars of certain spectral classes, but it is hoped that the dependence of such spectra upon absolute luminosities or other elements may be found in the near future.

Dr. Adams's contributions to other lines of astronomical research have been many, extensive, and fruitful. We mention three:

The spectrographic determination of the sun's rotational speeds by comparing the motions of approach of the eastern limb and the motions of recession of the western limb with the apparent motions of approach or recession of points on the solar meridian passing through the earth. The results form a monumental contribution to the complicated and still unsolved problem of the solar rotation.

His long exposures on the spectra of the present-day faint remnants of new stars formerly brilliant have shown that these stars are now of the Wolf-Rayet type.

The more thorough application of high dispersion spectroscopy to the study of the sun's chromosphere. Prior to the establishment of the Mount Wilson Solar Observatory this was essentially a total solar eclipse problem. Stratification of the chromosphere has been studied by Adams without an eclipse at least as successfully as it had formerly been studied at times of total solar eclipse.

Respectfully submitted.

W. W. CAMPBELL,
Chairman Henry Draper Committee.

REPORT OF THE COMMITTEE ON THE J. LAWRENCE SMITH FUND.

The committee on the J. Lawrence Smith fund reports as follows:

No. 3. Edmund Otis Hovey, curator in the department of geology and invertebrate paleontology in the American Museum of Natural History, New York, received in 1909 a grant of $400 to aid in the study of certain meteorites. The pressure of administrative duties has been so severe that the investigation is suspended, at least for a time, and Dr. Hovey proposed to return the grant. The committee hesitated, but at last accepted the proposal, and the amount of the grant, together with interest, has been repaid to the treasurer of the academy.

No. 4. C. C. Trowbridge, professor of physics in Columbia University, New York, has received from 1909 to 1917, grants amounting to $1,400 to aid in the study of meteor trains. The work of the last year has consisted of the further collection of illustrations of meteor trains and the study of spectrum observations. No further grant is sought.

No. 6. S. A. Mitchell, professor of astronomy in the University of Virginia, University, Va., received in 1915 a grant of $500 to aid in securing observations of paths and radiants of meteors, and in computing orbits when the observations are sufficient; further grants of $300 were made in 1916 and 1917. The war lessened the number of observations secured during 1917, but this lessened number amounted to 4,231, making the whole number of observations about

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19,000. An abstract of results for 1917 has been published by Dr. Olivier in a recent number of Popular Astronomy.

The committee is unanimous in recommending a further grant of $300 in aid of this promising research.

Grant No. 7. Dr. George P. Merrill, of the United States National Museum, received last November a grant of $400 to aid in further study of certain elements in meteorites. Of this grant he has spent $185, and there remains to his credit $215.

The J. Lawrence Smith fund now has a cash balance of income of $1,188.85. There is also a balance of invested income amounting to $1,532.50.

For the committee,

EDWARD W. MORLEY, *Chairman.*

REPORT OF C. C. TROWBRIDGE FOR 1917 ON GRANT FROM THE J. LAWRENCE SMITH FUND.

APRIL 13, 1918.

Prof. EDWARD W. MORLEY, LL. D.,
Chairman of the Committee on the J. Lawrence Smith Fund,
National Academy of Sciences.

DEAR PROF. MORLEY: I beg to submit herewith a brief report relative to the grant made to me from the J. Lawrence Smith fund for aid in work on the atmosphere of the earth and to the trains of meteors.

The progress for the year 1917 has been as follows: Work has been continued on the collection of illustrations of meteor trains; on the study of meteor-train theories, and study of the spectrum observations.

It has been shown that there is good reason to believe that the spectra of trains observed indicate a gas phosphorescence similar to that of "active" nitrogen (nitrogen in the phosphorescent state) rather than the light from hot metals as believed by the various observers. Further observations of importance have been made on the auroral features of the meteor-train zone. This phase of the investigation is bound up with meteor-train study for the following reasons:

The meteor-train zone and the main aurora are the same; the potential gradient across this zone is probably the cause of the visual effects in both cases. The drift of the atmosphere as shown by drifting trains in the meteor-train zone unquestionably has an important bearing on the electric discharges which cause the auroral glow.

FINANCIAL STATEMENT.

Total funds received to Dec. 31, 1916	$1,153.50
Total expenditures to Dec. 31, 1916	1,020.67
Balance, Dec. 31, 1916	132.83
(As per financial statement submitted Mar. 26, 1917.)	
Received from treasurer, National Academy of Sciences, Mar. 22, 1917	250.00
Total	382.83

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EXPENDITURES IN 1917.

Jan. —, M. M. King, typewriting	$2.40
Feb. —, Science reprints	8.00
Mar. —, Exchange on Washington check	.10
Mar. 12, George Merritt, jr., assistant, 23 hours	13.80
Apr. 2, J. Boldtman, photographer	1.50
Apr. 2, Bureau of supplies, Columbia University	1.20
Apr. 30, J. Boldtman, photographer	3.40
May 1, George Merritt, jr., assistant	19.60
May 10, bureau of supplies, Columbia University	1.60
June 1, Amy E. Davis, assistant	36.00
June 15, Mabel Weil, assistant	62.70
June 18, Printing, New Era Printing Co	5.89
	156.19

CASH ON HAND, DECEMBER 31, 1917.

Balance in Corn Exchange Bank	149.90
Cash	1.45
Balance in Washington Savings Bank	75.29
	226.64

CONDENSED STATEMENT.

Total funds received		1,403.50
Total expenditures to Dec. 31, 1917	$1,176.86	
Balance	226.64	
		1,403.50

Respectfully, yours,

C. C. TROWBRIDGE.

REPORT OF THE DIRECTORS OF THE WOLCOTT GIBBS FUND.

The directors of the Wolcott Gibbs fund for chemical research respectfully present the following report to the National Academy of Sciences.

During the past year no application was received for a grant from the fund, and owing to the disorganization of chemical research by the war, it was not thought worth while to try to get applications.

Holders of grants at present have reported as follows:

Grants 2 and 5.—Prof. M. E. Holmes, of Connecticut College, finds that the exacting duties of her new position will prevent her from continuing her research, and has returned the unexpended balance of the two grants, amounting to $86.32.

Grant 6.—Prof. G. P. Baxter, of Harvard University, has spent $194.31 for material and apparatus since the last report. No platinum was bought, as the war had rendered it too expensive. The three researches described in the last report have been finished, and accounts of the results will be published soon. These were—

(*a*) Electrolytic deposition in a mercury cathode, and the atomic weight of cadmium, with C. H. Wilson. A slight loss was discovered and corrected experimentally, after which eight determinations gave the atomic weight of cadmium as 112.40.

(*b*) Impurities in silver and iodine, with L. W. Parsons. In 1 gram of the silver used for atomic weight determinations 0.004 mg. of gas were found; in

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the iodine, 0.002 mg. of gas. Most exacting spectroscopic tests showed no impurities in the silver. These results dispose of the criticisms of P. A. Garye on the Harvard atomic weight determinations.

(*c*) The ratio of arsenic trioxide to iodine, with L. A. Gontz. The atomic weight, 74.96, was found for arsenic.

In addition a fourth research has been started—

(*d*) The atomic weight of mercury, with Matsuenke Kobayashi. All these researches but the last have been stopped by the enlistment of the graduate students in war service.

Grants 4 and 7.—Prof W. D. Harkins, University of Chicago, has bought a vacuum pump for $55, and is about to buy a still more efficient one.

He has studied the "Secondary valence and Werner's coordination number from the standpoint of the amines of cobalt" with G. L. Clark.

The existence of the salt $CoCl_3.10NH_3$ has been established; and the phenomena observed in the formation of this compound have never been studied, and some of its physical constants. The work was broken off by the enlistment of Mr. Clark in the service of the Government before it could be brought to an end. It will be continued as soon as possible, as it promises to show either that Werner's constitution of the cobaltamines is incorrect or that his coordination number must be changed from 6 to 10. Other results of great interest are also indicated.

Grant 8.—Prof. R. L. Datta, Presidency College, Calcutta, has sent orders for organic chemicals amounting to £10, but has received none because of the war.

The treasurer reports that the unexpended income of the fund amounts to $360.87. This includes the sum of $86.32 refunded from grants 2 and 5.

CHARLES L. JACKSON, *Chairman.*

The report was accepted.

REPORT OF THE COMMITTEE ON THE COMSTOCK FUND.

CORNELL UNIVERSITY, ROCKEFELLER HALL,
Ithaca, N. Y., April 10, 1918.

To the PRESIDENT OF THE NATIONAL ACADEMY OF SCIENCES:

SIR: On behalf of the committee in charge of the Comstock fund, I beg to make the following report:

Five years having nearly elapsed since the first award of the Comstock prize to Prof. (now Lieut. Col.) R. A. Millkan, the committee met in Philadelphia at the time of the November (1917) sessions of the academy, four members being present. After careful consideration of various suggestions previously made in writing at the request of the chairman, the committee unanimously recommended that the second award of the Comstock prize be made by the academy to Samuel Jackson Barnett, professor of physics at Ohio State University, for his investigations on magnetization by rotation.

In this research the following fundamental and very important facts were established:

1. That there are within the iron currents of negative electricity in orbital revolution;

2. That these gyrostatic systems have inertia and are capable of definite orientation or arrangement by the rotation of the body without the action of any external magnetic field; and

3. That such orientation manifests itself as a magnetization of the body as a whole.

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The committee further recommended that as in the case of the first award, the value of the prize be $1,500.

Yours, very truly,

EDW. L. NICHOLS,
For the committee.

REPORT OF THE COMMITTEE ON THE MURRAY FUND.

On November 1 the sum to the credit of the Murray fund was $569.61. The treasurer suggested, and as chairman I approved of, the investment of the major part of this sum in Liberty bonds, which, should the council decide to offer the medal this year, could readily be turned into cash. * * *

Very respectfully,

WM. H. DALL,
Chairman, Committee on Murray Fund.

REPORT OF THE COMMITTEE ON THE MARSH FUND.

The committee on the Marsh fund report as follows:

Grant No. 1.—Dr. J. M. Clarke reports progress in the assembling of material for his study of mutualism symbiosis and dependent life among animals.

Grant No. 2.—The committee recommend the appropriation of $250 to M. Ferdinand Canu, of Versailles, France for investigation in cooperation with Dr. R. S. Bassler, of the United States National Museum, of the early Teritary bryozoa of North America.

ELIAKIM H. MOORE, *Chairman.*

Report accepted and appropriation approved.

AMENDMENT TO CONSTITUTION.

The following amendment to the constitution was presented from the Committee of the Whole and adopted:

That the constitution be amended by substituting in Article II, section 1, lines 3 and 6 (Report, 1916) the word "four" for the word "six," so that it will read: "For a term of four years * * *."

Article II, section 1, as amended, reads:

SECTION 1. The officers of the academy shall be a president, a vice president, a foreign secretary, a home secretary, and a treasurer, all of whom shall be elected for a term of four years by a majority of votes present at the first stated meeting after the expiration of the current terms: *Provided*, That existing officers retain their places until their successors are elected. In case of a vacancy, the election for four years shall be held in the same manner at the meeting when such vacancy occurs, or at the next stated meeting thereafter, as the academy may direct. A vacancy in the office of treasurer or home secretary may, however, be filled by appointment of the president of the academy until the next stated meeting of the academy.

REPORT OF THE EDITORIAL BOARD OF THE "PROCEEDINGS."

The following report from the editorial board of the Proceedings of the National Academy of Sciences was presented by the chairman:

The board submits to the academy the following report of its activities:

1. Three volumes of the Proceedings have been completed and four numbers of the fourth volume have been issued.

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The statistics as to the make-up of the third volume, both in respect of subject matter and of source of the contributions, have been printed in the Annual Report of the Academy for 1917, and need not now be repeated except so far as covers one point.

The statistics of articles by members of the academy as compared with articles by nonmembers are interesting mainly in showing a progressive diminution in the percentage of articles by members, despite the increase in membership of the academy. If there are obstacles which can be removed and which hinder members of the academy from printing in the Proceedings, would it not be well to make efforts to remove them? The academy represents the highest point in American research, and if the Proceedings should actually contain articles representing the totality of the investigations of members of the academy, it would become thereby largely representative of all American research and of very high grade; and, furthermore, it would be more truly the proceedings of the academy in the sense that corresponding publications of foreign academies are representative of their research.

2. At the autumn meeting the terms of office of five members of the editorial board expired, and new appointments were made by the council as follows: Jacques Loeb, W. M. Wheeler, E. B. Frost, E. L. Thorndike, and E. H. Moore.

3. At the autumn meeting the board decided to put into operation certain changes in the typographical make-up of the Proceedings in the interest of economy. These changes have been made with satisfactory results.

4. The editorial board is of the opinion that in view of the now established and recognized position of the Proceedings as a medium of scientific publication, the members of the academy might well contribute more of their own papers to its pages than they now do, both from the standpoint of self-interest as well as from a sense of duty to the academy and what it stands for. In this connection the board would recommend that the academy adopt as a general principle the policy of requiring each recipient of a grant for research from any of its special funds to publish some account of the results of the researches under the grant in the Proceedings.

5. If the above recommendation is adopted, the board would further recommend that the academy suggest to the several committees having in charge trust funds from which grants are made that whenever accounts of researches under grants are published in the Proceedings there shall be paid over from the trust funds out of which the grants are made to the Proceedings account, if such action be permissible under the terms of the bequest, a sum of money to cover the expense of the publication at a rate of $6 per printed page.

Respectfully submitted.

RAYMOND PEARL, *Chairman.*

RECOMMENDATIONS FROM THE COUNCIL.

The following recommendations from the editorial board of the Proceedings through the Council were approved by the academy and the home secretary was instructed to bring these recommendations to the attention of the members of the academy and the chairmen of the trust funds:

That members of the academy be requested to contribute their own papers to the Proceedings.

That the policy of requiring each recipient of a grant for any research from any of the special funds to publish an account of the results of the researches under the grant in the Proceedings be approved.

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That the academy request the committees and trustees of the several trust funds of the academy from which grants are made that whenever accounts of researches under grants are published in the Proceedings there shall be paid over, from the trust fund out of which the grants are made, to the Proceedings account, if such action is permissible under the terms of the bequest, a sum of money to cover the expense of the publication.

REPORT OF FINANCE COMMITTEE OF THE "PROCEEDINGS."

The estimated net cost of the Proceedings for 1918 is $5,600.

The estimated income is as follows:

From subscriptions (provided each member of the academy becomes responsible for one subscription)	$1,800
One-third guaranty fund of $2,500 is	833
Estimated income of Billings fund	187
Sundry other income (members' dues, $850; N. R. C., $400; Dr. Walcott, special, $100)	1,350
Total estimated income	4,170
Total estimated deficit	1,430

If recommendation of the editorial board that space for reports of special grants in Proceedings be specially paid for be adopted, this deficit will be reduced to $1,200.

The committee plans to raise funds to meet this deficit.

C. B. DAVENPORT, *Chairman.*
FRANK R. LILLIE.
RAYMOND PEARL.

AWARD OF MEDALS.

At the annual dinner held Tuesday evening at the Cosmos Club the following medals and awards were presented:

The Comstock prize of $1,500 for discoveries in magnetism and electricity was awarded to Samuel Jackson Barnett, Ohio State University, Columbus, Ohio.

The Draper medal for discoveries in astronomical physics to Walter Sydney Adams, Mount Wilson Solar Observatory, Pasadena, Cal.

The Daniel Giraud Elliot medal and honorarium for work in zoology to Frank M. Chapman, American Museum, New York.

ELECTIONS.

MEMBERS OF THE COUNCIL.

W. H. Howell, to succeed himself, term expiring in 1921.

C. G. Abbot, to succeed John M. Coulter, term expiring in 1921.

NEW MEMBERS.

Robert Grant Aitken, astronomer, Lick Observatory, California.

George Francis Atkinson, botanist, Cornell University, Ithaca, N. Y.

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George David Birkhoff, mathematician, Harvard University, Cambridge, Mass.

Percy Williams Bridgman, physicist, Harvard University, Cambridge, Mass.

Stephen Alfred Forbes, zoologist, Urbana, Ill.

John Ripley Freeman, engineer, Providence, R. I.

Charles Judson Herrick, neurologist, University of Chicago, Chicago, Ill.

Ludvig Hektoen, pathologist, University of Chicago, Chicago, Ill.

Frank Baldwin Jewett, engineer, Western Electric Co., New York, N. Y.

Walter Jones, physiologist, Johns Hopkins University, Baltimore, Md.

Irving Langmuir, chemist, General Electric Co., Schenectady, N. Y.

Charles Elwood Mendenhall, physicist, University of Wisconsin, Madison, Wis.

John Campbell Merriam, paleontologist, University of California, Berkeley, Cal.

Henry Norris Russell, astronomer, Princeton University, Princeton, N. J.

David Watson Taylor, engineer, rear admiral and Chief of the Bureau of Construction and Repair, United States Navy.

ADJOURNMENT.

The president, in closing, stated the present condition of the aircraft work of the Government.

The home secretary was requested to transmit the thanks of the academy to the Secretary of the Smithsonian and the officers of the United States National Museum and to the Cosmos Club for the courtesies extended to the members of the academy during the annual meeting.

PROGRAM OF SCIENTIFIC SESSIONS.

MEETING OF APRIL 22–24, 1918.

MONDAY, APRIL 22.

MORNING SESSION.

The effects of a prolonged reduced diet on 25 college men.—Francis G. Benedict: I. On basal metabolism and nitrogen excretion. Walter R. Miles (introduced by F. G. Benedict): II. On neuromuscular processes and mental condition (illustrated). H. Monmouth Smith (introduced by F. G. Benedict): III. On efficiency during muscular work and general muscular condition (motion pictures).

W. S. Halsted: The partial occlusion of great arteries in man and animals (illustrated).

S. J. Meltzer: Three papers (illustrated).—(*a*) The favorable effect of subcutaneous injection of magnesium sulphate in tetanus. (*b*) The possible danger

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of intravenous injection of magnesium sulphate. (c) The antagonistic and curative action of calcium salts in these cases.

Henry Fairfield Osborn: The Liberty field hospital ward. Designed on the unit-construction plan. Portable. Adapted to American overseas summer and winter service (motion pictures).

Simon Flexner: The war and medical research (illustrated).

AFTERNOON SESSION.

Edward Kasner: Conformal geometry.

S. J. Barnett (by invitation. Comstock prize recipient): Magnetism by rotation (illustrated).

A. A. Michelson: On the correction of optical surfaces.

W. W. Campbell: Some recent observations of the brighter nebulæ (illustrated).

R. A. Millikan: Physical researches for the war.

First William Ellery Hale lecture, by John C. Merriam, professor of paleontology, University of California. Subject: "The beginnings of human history from the geologic record."

TUESDAY, APRIL 23.

MORNING SESSION.

F. W. Clarke: Notes on isotopic lead.

Lawrence J. Henderson (introduced by Raymond Pearl): The physico-chemical properties of gluten.

Thomas Wayland Vaughan (introduced by David White): Correlation of the Tertiary formations of the southeastern United States, Central America, and the West Indies.

W. M. Davis: Coast survey charts and fringing reefs of the Philippine Islands (illustrated).

Henry Fairfield Osborn and William K. Gregory: Recent researches on the skeletal adaptations and modes of locomotion of the sauropod dinosaurs (illustrated).

Charles D. Walcott: Some additional data on the Cambrian Trilobites (illustrated).

C. R. Van Hise: The development of governmental regulations during the world war.

AFTERNOON SESSION.

C. Hart Merriam: The big bears of North America.

G. H. Parker: The growth of the Pribilof fur-seal herd between 1912 and 1917 (illustrated).

Henry H. Donaldson: A comparison of the growth changes in the nervous system of the rat with the corresponding changes in man (illustrated).

Robert M. Yerkes (by invitation): Measuring the mental strength of an army (illustrated).

Second William Ellery Hale lecture, by John C. Merriam, professor of paleontology, University of California. Subject: "The beginnings of human history from the geologic record."

Arthur Gordon Webster: Some considerations on the exterior ballistics of a gun of 75 miles range.

J. P. Iddings (read): Biographical memoir of the late Arnold Hague.

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C. G. Abbot (read): Periodicity in the variation of the sun.

John M. Clarke (read by title): Biographical memoir of the late William Bullock Clark.

Edwin H. Hall (read by title): Ionization in solid metals.

E. L. Nichols and H. L. Howes: On the types of decay of phosphorescence.

AUTUMN MEETING.

The autumn meeting of the academy was held in the Johns Hopkins club room, Johns Hopkins University, Baltimore, Md., November 18 and 19, 1918.

The following members were present:

Abbot, C. G.	Gomberg, Moses	Merriam, J. C.
Abel, J. J.	Halsted, W. S.	Michelson, A. A.
Ames, J. S.	Harrison, R. G.	Moulton, F. R.
Bliss, G. A.	Holmes, W. H.	Nichols, E. F.
Campbell, D. H.	Howard, L. O.	Pupin, M. I.
Castle, W. E.	Howe, H. M.	Ransome, F. L.
Clarke, F. W.	Howell, W. H.	Russell, H. N.
Clarke, J. M.	Iddings, J. P.	Smith, E. F.
Conklin, E. G.	Jennings, H. S.	Thorndike, E. L.
Cross, Whitman	Jones, Walter	Vaughan, V. C.
Davenport, C. B.	Leuschner, A. O.	Walcott, C. D.
Davis, W. M.	Lewis, G. N.	Webster, A. G.
Franklin, E. C.	Lindgren, Waldemar	Welch, W. H.
Freeman, J. R.	Mendenhall, C. E.	Wood, R. W.

BUSINESS SESSIONS.

ANNOUNCEMENT OF DEATHS.

The president announced the following deaths: S. W. Williston and G. K. Gilbert.

ASSIGNMENT OF BIOGRAPHICAL MEMOIRS.

Memoir of Richmond Mayo Smith assigned to Edwin R. A. Seligman, Samuel W. Williston to Richard S. Lull, G. K. Gilbert to William M. Davis.

PROCEEDINGS.

The president announced the following changes in the board of editors:

Retiring in 1918: J. J. Abel, J. M. Clarke, J. P. Iddings, R. A. Millikan, and Alexander Smith.

New members, retiring in 1921: J. M. Clarke, Ludvig Hektoen, H. S. Jennings, R. A. Millikan, and W. A. Noyes.

The managing editor of the Proceedings, Mr. E. B. Wilson, was reelected for the year ending November 30, 1919.

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RESIGNATION OF THE HOME SECRETARY.

The resignation of the home secretary, Mr. Arthur L. Day, was presented with the statement that the pressure of duties in connection with war activities would keep him away from Washington, and that he was severing his connection with the Geophysical Laboratory in order to undertake a greater war responsibility in connection with the Corning Glass Works, at Corning, N. Y. The academy approved the recommendation of the council that the resignation of Mr. Arthur L. Day as home secretary be accepted with an expression of regret that he feels compelled to give up the home secretaryship, and of appreciation for his valuable services in that office. The election of a home secretary was left for consideration at the next stated meeting of the academy, as provided for in the constitution.

NATIONAL RESEARCH COUNCIL.

The president presented the following communication from the President of the United States:

NATIONAL RESEARCH COUNCIL.

EXECUTIVE ORDER ISSUED BY THE PRESIDENT OF THE UNITED STATES MAY 11, 1918.

The National Research Council was organized in 1916 at the request of the President by the National Academy of Sciences, under its congressional charter, as a measure of national preparedness. The work accomplished by the council in organizing research and in securing cooperation of military and civilian agencies in the solution of military problems demonstrates its capacity for larger service. The National Academy of Sciences is, therefore, requested to perpetuate the National Research Council, the duties of which shall be as follows:

1. In general, to stimulate research in the mathematical, physical, and biological sciences, and in the application of these sciences to engineering, agriculture, medicine, and other useful arts, with the object of increasing knowledge, of strengthening the national defense, and of contributing in other ways to the public welfare.

2. To survey the larger possibilities of science, to formulate comprehensive projects of research, and to develop effective means of utilizing the scientific and technical resources of the country for dealing with these objects.

3. To promote cooperation in research, at home and abroad, in order to secure concentration of efforts, minimize duplication, and stimulate progress; but in all cooperative undertakings to give encouragement to individual initiative, as fundamentally important to the advancement of science.

4. To serve as a means of bringing American and foreign investigators into active cooperation with the scientific and technical services of the War and Navy Departments and with those of the civil branches of the Government.

5. To direct the attention of scientific and technical investigators to the present importance of military and industrial problems in connection with the war and to aid in the solution of these problems by organizing specific researches.

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6. To gather and collate scientific and technical information at home and abroad, in cooperation with governmental and other agencies, and to render such information available to duly accredited persons.

Effective prosecution of the council's work requires the cordial collaboration of the scientific and technical branches of the Government, both military and civil. To this end representatives of the Government, upon the nomination of the president of the National Academy of Sciences, will be designated by the President as members of the council, as heretofore, and the heads of the departments immediately concerned will continue to cooperate in every way that may be required.

WOODROW WILSON.

THE WHITE HOUSE, *May 11, 1918.*

FUNDS AVAILABLE FOR THE NATIONAL RESEARCH COUNCIL

Carnegie Institution	$100,000.00
W. W. Keen	483.57
Rockefeller Foundation	50,000.00
President's fund	120,000.00
Total available for fiscal year 1919	270,483.57

LONDON CONFERENCE.

The President read the following resolutions adopted at a conference of delegates from the national academies of countries at war with the central powers held at London October 9, 1918, received from the foreign secretary, Mr. Hale, who was chairman of the delegation from the National Academy of Sciences, the other members being Messrs. A. A. Noyes, W. F. Durand, S. Flexner, H. A. Bumstead, and J. J. Carty:

(1) That a committee of inquiry be constituted by the conference, the academies of the countries at war with the central powers having power to add further members. This committee shall prepare a general scheme of international organizations to meet the requirements of the various branches of scientific and industrial research, including those relating to national defense. (The committee will meet in Paris during the second fortnight in November.)

(2) Each of the academies represented at the conference shall be invited to initiate the formation of a national council for the promotion of the researches specified in resolution (1).

(3) An international council, having as nucleus the committee specified in resolution (1), shall be formed by the federation of national councils.

(4) The conference being of the opinion that all industrial, agricultural, and medical progress depend on pure science, draws the attention of the various Governments to the importance of theoretical and disinterested researches, which after the restoration of peace should be supported by large endowments. The conference urges similarly the creation of large laboratories for experimental science, both private and national.

Moved: That the action of the academy delegates favoring the above resolutions adopted by the interallied conference in London be entered in the minutes and approved by the academy.

Adopted.

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LIBRARY.

The following recommendation from the council was considered:

Moved: That the council recommend that the academy go on record as favoring the donation of publications of a scientific and technical character for its library.

Adopted.

AUDITING COMMITTEE.

The president announced the appointment of Mr. C. G. Abbot, Mr. L. O. Howard, and Mr. David White to audit the accounts of the treasurer.

PETITION TO CONGRESS.

Mr. Davis presented for the consideration of individual members of the academy the following petition for transmission to Congress and moved its adoption:

The undersigned members of the National Academy of Sciences, meeting in Baltimore, November 18, 1918, petition the Congress of the United States to take action, in consultation with the Governments of many other countries, toward the formation at as early a date as possible of a league of nations for the maintenance of peace.

This was signed by many members and transmitted to Congress.

The home secretary was requested to transmit the thanks of the academy to the president and trustees of Johns Hopkins University, the members of the Johns Hopkins Club, and the members of the academy resident in Baltimore serving as the local committee for the courtesies extended to the members of the National Academy of Sciences at the autumn meeting, 1918.

SCIENTIFIC SESSIONS.

NOVEMBER 18 AND 19, 1918.

Cloud reflection and the albedo of the earth and Venus.—C. G. Abbot.

Colorimetry of white surfaces.—A. H. Pfund, introduced by J. S. Ames.

The inorganic constituents of lobster shells.—F. W. Clarke and G. Steiger.

Quantitative relations between chromatin and cytoplasm in the genus Arcella, with their relations to external characters.—R. W. Hegner, introduced by H. S. Jennings.

The physiological effects of air concussion.—D. R. Hooker, introduced by W. H. Howell.

Two new factors in blood coagulation.—W. H. Howell.

Comparative morbidity of white and colored troops.—C. B. Davenport and Albert G. Love.

Theory of wind instruments.—A. G. Webster.

On the ballistic resistance function.—A. G. Webster.

On the dynamics of the rifle fired from the shoulder.—A. G. Webster.

Second report on the researches on the chemical and mineralogical composition of meteorites.—G. P. Merrill.

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Hydrocephalus: Experimental and clinical study (illustrated).—W. E. Dandy.

Clinical and experimental observations in cases of arterio-venous and lymphatico-venous fistulae (illustrated).—W. S. Halsted.

Is the arrangement of the genes in the chromosome linear? (illustrated)—W. E. Castle.

Cause of Phyllomania in Begonia (illustrated).—E. F. Smith.

Recent epidemics of pneumonia in army camps (illustrated).—W. G. MacCallum, introduced by H. S. Jennings.

Differential corrections of ballistics.—G. A. Bliss.

Some results of studies of influenza at an army camp.—Dr. Wolbach.

Communicable diseases in an army camp.—V. C. Vaughan.

Physiological effects of light of short wave length.—R. W. Wood.

The following read by title:

Kinetics and thermodynamics.—G. N. Lewis.

Perturbations and tables of the minor planets discovered by James C. Watson, Part II.—A. O. Leuschner.

Mathematical tables.—C. E. Van Orstrand.

Biography of George Davidson.—W. W. Campbell.

Biography of James Mason Crafts.—C. R. Cross.

Biography of Alpheus Spring Packard.—T. D. A. Cockerell.

Biography of Eugene Waldemar Hilgard.—F. Slate, jr.

DECEASED MEMBERS.

GROVE KARL GILBERT.[1]

By Herman Leroy Fairchild.

Grove Karl Gilbert was one of the most eminent geologists of the world. As he was a native of Rochester and an honorary member of this society,[2] the Academy of Sciences has special pride in his life and work.

Dr. Gilbert was born in Rochester, May 6, 1843. His father was the well-known portrait painter, Grove Sheldon Gilbert. For many years the family lived in the little house at the intersection of Culver Road and Merchants Road, but Karl was not born there. He had six brothers and sisters. The usual want of thrift and acquisitiveness in men of the artistic temperament held in the case of the father, and it appears that the family was poor and that Karl had to obtain some help for his course in college. He graduated as bachelor of arts at the university in 1862.

Following his graduation he taught for one year as principal of the schools in Jackson, Mich. He then returned to Rochester and until 1868 was assistant to Henry A. Ward. This work on the geologic and zoologic material of Ward's establishment probably determined his future scientific career. Many thousands of the labels

[1] Memoir presented to the Rochester Academy of Sciences.
[2] Rochester Academy of Sciences.

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in the University Geological Museum, which was the famous Ward collection, carry the pen work of young Gilbert.

In 1869 he began, on the Ohio Geological Survey, under Prof. J. S. Newberry, his geologic work. That this work was deliberate choice appears from the "Historical sketch" by Newberry, in the report for 1869 (p. 9), where we read:

> Of the other members of the corps, Messrs. Gilbert and Sherwood were geologists who had devoted much time to practical geology in New York and Pennsylvania, and who, for the purpose of adding to their experience, volunteered their services for no other compensation than their traveling expenses.

In the report for 1870 Dr. Newberry writes:

> The fossil fishes and fossil plants found in the State have been described by myself. They have been drawn by Mr. T. Y. Gardner and Mr. G. K. Gilbert in a style that has not been surpassed in this country, and some of their work is equal to any of a similar character done by the best European draftsman (p. 8).

This volume contains a short report by Gilbert on three counties in the northwestern part of the State.[1] A fuller report on the same district is attached to a report on the surface geology of the Maumee Valley, found in volume 1, of the final reports of the Newberry survey. This writing, published in 1873, contains six maps, evidently all his own work. The first two maps show the beaches of the ancient glacial waters in the Maumee Valley, and the correlation of the highest shore with the pass at Fort Wayne.

These fine maps are the first ever made in delineation of ancient lake beaches and correlation with the controlling outlet. The field work for this report was done in 1869 and 1870, when he was only 27 years of age. At this time Gilbert did not recognize the receding ice sheet as the dam that held up the ancient waters, but he did clearly postulate deformation of the earth's surface as one cause of the variation of levels. He says (p. 551):

> The more general conclusion that the system of raised beaches signify a succession of flexures of the earth's surface, rather than successive stages of subsidence due to gradual removal of a barrier of tidewater, or the gradual wear of a barrier of stone, does not rest on this single fact.

Even then he knew something of the change of levels in the Ontario Basin, for he immediately says, in citing other similar facts: "There is evidence that Lake Ontario, at Rochester, N. Y., has stood 70 feet lower than it does now" (p. 552). Some sentences in the same connection illustrate his capacity for generalization:

> While these facts abundantly prove that a simple theory of gradual drainings, by the elevation en masse of the lake regions, is entirely inadequate, they are too fragmentary to define clearly the general synchronism and se-

[1] Part VII, pp. 485–499.

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quence of the local movements to which they testify. Nevertheless, it is something to have learned that the writhings of the surface of the earth, which has in the ages so many times remapped the continents, has also been the great immediate cause of the transformation of the great lakes, and that, continuing through the latest distinguishable geological epoch and its prolongation the historical, it has now ceased.

Dr. Newberry was the first geologist to recognize the ice barrier as the cause of the high-level waters in the Laurentian Basin, and it is interesting to find a footnote over his initials at the bottom of the same page (552), reading as follows:

In the discussion of these facts cited by Mr. Gilbert, and others of similar character, it should be remembered that the retreating glacier must have, for ages, constituted an ice dam that obstructed the natural lines of drainage, and may have maintained a high surface level in the water basin which succeeded it.

The substance of Gilbert's report in the 1873 volume of the Ohio Survey had previous publication by permission in the American Journal of Science in 1871.[1] An abstract was also printed in the proceedings of the New York Academy of Sciences of February 20, 1871 (pp. 175–178).

In 1871 Gilbert joined the Wheeler survey of the western Territories and began the many years of work in the far West. From 1875 he was on the survey under Maj. Powell. The United States Geological Survey was organized in 1879 with Clarence King as Director, and young Gilbert became a member. From that time to his death, May 1, 1918, he was continuously on the national survey.

Gilbert was not a prolific writer, as compared with others and judged by his work and ability. Down to 1891 the bibliographic list carries 70 titles, 4 of which have associated authors. His initial publication, in recognized geologic mediums, was in 1871, on the Cohoes mastodon in the Twenty-first Annual Report of the New York State Cabinet of Natural History. His next three articles have been noted above, relating to Ohio geology and the ancient beaches. From 1871 his papers are mostly in description of features of the western country. The most important of his earlier papers is the report on the Henry Mountains, published in 1877. In this classic paper he described a new type of mountains, now fully recognized. These were originally domes, or areas of sedimentary strata lifted by the injection of lava from beneath. Quoting his own description, page 19:

The lava of the Henry Mountains behaved differently. Instead of rising through all the beds of the earth's crust, it stopped at a lower horizon, insinuated itself between two strata, and opened for itself a chamber by lifting all the superior beds. In this chamber it congealed, forming a massive body of trap. For this body the name laccolite (cistern stone) will be used.

In later years the name has been changed to laccolith. Subsequent erosion of these uplifts by doming has often destroyed the arching

[1] Vol. 1 of third series, pp. 339–345.

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form or obscured the primitive shape and exposed the injected igneous heart. The latter part of this book is a discussion of land sculpture. In this statement of the principles of erosion and the origin of topographic forms he shares with Newberry and Powell the honor of a pioneer.

Probably his most famous writing is the work on Lake Bonneville. This is the initial volume of the series of quarto monographs published by the National Survey and bears the date of 1890. This describes the wide expanded predecessor of the present Great Salt Lake, which existed in glacial time when humidity and rainfall of the Great Basin produced the vast lake which overflowed northward to the Columbia River. Great Salt Lake is only the saline remnant of that desiccated fresh-water body.

This handsome quarto volume contains a chapter on "Topographic features of lake shores," which is the classic writing on shore-line topography.

It is interesting to note that he published no articles relating to the Rochester region until after his long period of western exploration. His first publication in reference to the Ontario basin was in 1885, on the Iroquois shore line; although he then called it simply the old shore line of Ontario. Between then and 1891 he published six papers on the Pleistocene features or glacial history of the Ontario basin; and one on the sink ridges near Caledonia.

From 1892 to 1900, eight years, his list of writings is 40; covering a wide range of subjects in geology. Of these 8 related to western New York. From 1901 to 1905 25 titles are on record, of which only 2 concern western New York. During 1906 and 1907 he published 9 articles, one being on Niagara. In 1908 only four articles, including another on Niagara, are recorded in the bibliography. Since 1908 only five titles are credited. All together this makes 156 titles, of which 18 relate to the geology of western New York or the Ontraio basin.

The few papers published in later years is explained by his poor health, due to a slight stroke of apoplexy. After this time by very careful living he was able to do some work in a deliberate way. His latest study was the transportation of detritus by streams, with reference to hydraulic mining in California. This work, spread over several years, was published last year, being his last publication. It is entitled "Hydraulic-mining Debris in the Sierra Nevada," and is Professional Paper 105 of the survey list, forming a quarto of 154 pages, with numerous maps and reproduction of photographs.

Dr. Gilbert's only writing for school textbooks is his Introduction to Physical Geography, in collaboration with Prof. A. P. Brigham. This was published in 1892 by D. Appleton & Co.

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Geology is so broad and comprehensive and so inviting in many directions that some men with active minds and lively interest scatter their studies over diverse fields. Dr. Gilbert more wisely confined his work to physical geology, especially geodynamics, in which he was recognized as a master. He published practically nothing in biologic geology or paleontolgy; and almost nothing in stratigraphy and petrology.

His geologic interest in his home region was mainly in glacial problems, especially the glacial lake Iroquois and the deformation of the Ontario basin. He was the first geologist to appreciate the complexity of the Pleistocene history of the valley. As early as 1885 he recognized the three controlling factors: (*a*) The damming effect of the waning glacier and the glacial nature of the earlier waters; (*b*) the succession of water levels due to opening of different outlets or places of escape for the impounded waters, by the recession of the glacier front; and (*c*) the dislocation and canting of the water planes by the tilting uplift of the land. His accurate conclusions regarding the complex history are embodied in a number of short papers, and especially in a chapter in the Sixth Annual Report of the Commissioners of the State Reservation at Niagara for the year 1890. The title of this important but little-known paper is "The History of Niagara."

Dr. Gilbert's mind was of the reflective philosophic type. He sought for the explanation and relationship of phenomena. His calm judgment and clear discrimination joined to a spirit of fairness and with gentle manners caused him to be much sought as a critic and helper. He was a sort of father-adviser to the members of the survey. Doubtless much of his thought has found expression in the writings of the younger men, who revered and loved him. The writer of this appreciation never heard him say a harsh word of anyone. He was reserved in personal matters, but it is known that the death of a young daughter affected and saddened his life. His wife, who was Fannie L. Porter, died over 20 years ago. Two sons are living.

Dr. Gilbert received many honors. The University of Rochester gave him the master's degree in 1872 and the doctor of laws degree in 1898. The latter degree was also conferred by the University of Wisconsin. He was the fourth president of the Geological Society of America, in 1892, and was again president in 1909, the only man honored by a second term. In 1899 he was president of the American Association for the Advancement of Science, probably the highest honor in the gift of American science. Naturally he was active and prominent in the scientific societies of the National Capital, and was a member of the National Academy of Sciences. He was one of the

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very few honorary members of this society.[1] In 1892, when the American Association for the Advancement of Science held its annual meeting in Rochester, this academy held a special meeting in Music Hall complimentary to the association, and the lecture of the evening was given by Gilbert, the subject being "Coon Butte and the theories of its origin." The relief map which he used on that occasion was donated to the university museum. It may be said that this was one of the very few times in which his theory has been proven wrong.

On the approach of his 75th anniversary, the 6th of last May, his friends were asked to send to the survey letters of appreciation, to be handed to him on that day. Unhappily he passed away on the 1st of the month at Jackson, Mich.

(Extract from SCIENCE, n. s., vol. 48, No. 1233, Aug. 16, 1918, pp. 151–154.)

In the Journal of Geology Prof. Thomas C. Chamberlin pays the following editorial tribute to the late Dr. Gilbert:

"The passing of Dr. Gilbert after almost 75 years of activity deprives geological science of one of its ablest and most honored representatives. It is permitted to few men to leave an equally enviable record. To an unusual degree his work was distinguished by keenness of observation, by depth of penetration, by soundness in induction, and by clarity of exposition. It is doubtful whether the products of any other geologist of our day will escape revision at the hands of future research to a degree equal to the writings of Grove Karl Gilbert. And yet this is not assignable to limitation of field, or to simplicity of phenomena, or to restriction in treatment. The range of his inquiries was wide, his special subjects often embraced intricate phenomena, while his method was acutely analytical and his treatment tended always to bring into declared form the basal principles that underlay the phenomena in hand.

"In the literature of our science the laccolith will doubtless always be associated with the name of Gilbert. In its distinctness as a type, in its uniqueness of character, and in the definite place it was given at once by common consent, one may almost fancy a figurative resemblance between the laccolith and its discoverer and expositor. Gilbert's monographs on the Henry Mountains and on Lake Bonneville will long stand as unexcelled models of monographic treatment. His contributions to physiographic evolution, particularly his analysis of the processes that end in base-leveling, link his name with that of Powell and give to these two close friends a unique place as joint leaders in interpreting morphologic processes. Glacial and hydraulic phenomena were also fields in which Gilbert's powers as an investigator and expositor were signally displayed.

[1] Rochester Academy of Sciences.

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"In accuracy of delineation, in clearness of statement, and in grace of diction Gilbert's contributions are certain long to stand as models of the first order. His personality was of the noblest type; he was a charming companion in the field; he was a trusted counselor in the study. The high place he has held in the esteem of coworkers is quite certain to merge into an even higher permanent place to be accorded him by the mature judgment of the future."

(Extract from Science, n. s. July 19, 1918, p. 65.)

SAMUEL WENDELL WILLISTON.

By J. M. ALDRICH, West Lafayette, Ind.

Samuel Wendell Williston, the eminent paleontologist and dipterist, died in Chicago on August 30, 1918. At the time of his death and for some years previous he was professor of paleontology and director of the Walker Museum in the University of Chicago.

He was born in Boston on July 10, 1852, and was therefore a little past 66 years old. His father was a blacksmith, uneducated but of native ability, who removed with his family to Manhattan, Kans., in 1857. Here young Williston's boyhood was spent, and in due time he entered the agricultural college in his home town, graduating from it in 1872. But his college course was interrupted, for he ran away from home at 18 and went to work as a railroad laborer, from which humble position he rose before he was 20 to be a transit man at a handsome salary for that time. However, he suffered greatly from malaria, and had to resign and go back home; after recuperating he finished his college course. Railroad engineering went flat in the panic of 1873, and he began to study medicine, "reading" in the office of a local doctor. In the summers of 1874 and 1875 he assisted Prof. B. F. Mudge on fossil collecting expeditions in western Kansas, the work being done for Prof. Marsh, of Yale University. He spent the winter of 1875–76 in the medical school of the University of Iowa, and was invited to come to Yale to see Marsh in the spring; this resulted in a contract to work for Marsh for three years at $40 a month, and in all to almost continuous employment with him for nine years, until 1885. He managed to finish his medical course and get his M. D. at Yale in 1880. But by this time his scientific bent was strongly developed, and it soon appeared that his work lay in following it rather than in the practice of medicine. He specialized in paleontology, and received his Ph. D. under Marsh in 1885. His genius for anatomy led to an appointment as demonstrator in Yale Medical School the following year, and after a short apprenticeship to the full professorship in human anatomy in 1887—a striking recognition of his ability.

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After three years in this position he accepted a call to the University of Kansas in 1890 as professor of historical geology and paleontology. Twelve years of his prime were spent in this institution—years crowded with productive labor. He helped organize the medical department of the university, and took on the deanship of it along with his other work; this almost broke his vigorous health, and he had to slacken his pace—perhaps never again quite regained it.

The consciousness that he was working beyond his strength had something to do with his going to the University of Chicago in 1902 as professor of paleontology. Here he was able to concentrate on a single specialty, officially at least, as he left medicine behind and thought he had left entomology also. In this place he spent the last 14 years of his life, beginning under some unexpected handicaps and gradually working up to full recognition and honor.

In the outline just given entomology is hardly hinted at, for the reason that Williston never held an official entomological position. But he found time to do much valuable work as a pioneer in dipterology. His employer would not allow him to publish in paleontology, and he sought a field outside where he could be free to work and publish; this he found in the Diptera. His interest in the flies began to be serious about 1878. At this time Osten Sacken had returned to Europe, and there was not a single American student of the order but Edward Burgess, the Boston yacht designer, who published only one small paper. So Williston was virtually alone on the Continent. In the absence of guidance, he plowed his way by main strength (as he often narrated to the writer) through descriptions of species until here and there he made an indentification, which served as an anchor point for a new offensive. He had few definitions of genera, so had to work backward from the species. After a year or two of this tedious and time-wasting effort he came upon Schiner's Fauna Austriaca, in which the Austrian families, genera and species of Diptera, as known up to 1862–1864, are analytically arranged and succinctly described. To his immense relief and satisfaction, he now found that all his American flies could be traced to their families, and most of them to their genera, in this fine work. He was so impressed by the saving of time accomplished that his own publications coming later show the effect of this early experience on every page; everywhere he has the beginner in mind and is clearing the way for him.

In a few years he began publishing tentative papers analyzing the American families and genera of the flies. These he extended and enlarged in a pamphlet in 1888, and again in a bound volume in 1896; and in 1908 published a third edition still more complete, with 1,000 figures, his well-known Manual of Diptera. This third

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edition is his main contribution to entomology. It is a handbook unapproached by anything else dealing with a large order of insects. From necessity he published it at his own expense; it was eight years before the receipts from sales covered the cost of printing, but happily he lived to see this consummation.

His other papers of his early period, 1881–89, dealt with Asilidae, Conopidae, Tabanidae, and smaller groups, and especially with Syrphidae, in which his fine monograph of 1886 is still in universal use, and by the taxonomic genius of its author has created in the United States an ineradicable belief that the family is an easy one, well adapted for the beginner to publish in, a mistaken belief, but highly complimentary to the monographer.

From 1890 his more important papers were concerned with tropical Diptera (Mexico, St. Vincent, Brazil) and with bibliography. As his official duties grew more exacting he gradually abandoned entomology, but he had as many farewell appearances as an opera singer, for he could not resist the temptation to come back again and again. Even as late as the spring of 1917, when he was visiting the writer and reveling once more in a collection of Diptera, his old enthusiasm came back so strongly that he planned describing some new genera, and did in fact publish one (Annals Ent. Soc. Amer., x, 23). But after 1896 he did little work on the order except in preparing the third edition of his Manual, which cost him two years of arduous work, as he drew 800 figures with his own hand. His deep interest in genera and his very wide acquaintance with them, together with his universally recognized taxonomic ability, made him in the period 1890–1900 the peer of Osten Sacken, Brauer, and Mik as a world authority in Diptera.

The types of Williston's new species are much scattered. His Syrphidae were acquired by the National Museum; the rest of his earlier collections by the University of Kansas; his Biologia material and that from St. Vincent went to London and, I understand, were finally deposited in the British Museum; the American Museum of Natural History obtained his later collections, including some duplicates of type series from St. Vincent and perhaps Mexico. Williston did not believe in designating a single-type specimen, hence in some cases his types of the same species are in two museums. He had no collection of Diptera in his last years, although he still retained his fine library in the order.

Although he never gave any formal entomological courses, he gave informal and even more valuable assistance both in Kansas and Chicago to several entomologists who were specializing on Diptera, among them W. A. Snow, Hugo Kahl, C. F. Adams, A. L. Melander, and myself. We all admired him and our admiration grew into deep love and veneration with the passing years. He had students outside

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of entomology like E. C. Case and C. E. McClung, who achieved high scientific standing. His lecture courses in palaeontology were full of broad generalizations about evolution and in the highest degree stimulating and profitable to students with biological training, as I am informed by Melander, who took them. He did not have large classes at any time and his lectures were mostly informal in style, drawn from a rich experience and given in intimate association with the student, the kind that would make a deep impression. But his life work was mainly directed to the larger circle outside his institution.

While in New Haven he received a visit from C. V. Riley, who urged him to come to Washington as first assistant in the Division (afterwards Bureau) of Entomology. But Williston entertained a shrewd doubt as to whether he could be happy in a position subordinate to Riley, and declined the offer, although its acceptance would have meant a permanent position at an increased salary. This incident was narrated to me several times by Williston; it occurred about 1885.

In the last few years Williston published two volumes on fossil reptiles, his greatest specialty, and last winter was working on a handbook of reptilia, which was probably near completion when he was compelled to abandon it. If this volume can be printed, it will close up his work on the reptiles about as well as his Manual of Diptera did for the flies. My last mental picture of the man represents him on a day last winter, sitting at a table before a window in his study at home, in one hand a long-snouted reptilian skull, in the other a drawing pen, with which he was rapidly making a sketch of it.

He attended the Pittsburgh meeting of the Entomological Society of America last winter and gave reminiscences of his early work on Diptera to an interested audience.

In physique he was large and vigorous, and mentally he was greatly endowed. I think I shall offend no living American dipterist when I say that he towered above us all. The truth of the assertion will be more clearly evident if we consider that his work on Diptera was never more than a side line, an absolute gift to science, accomplished in odd times while he was attaining distinction in anatomy and world-wide reputation in palaeontology, his main specialties.

Considering the positiveness of his opinions and his frankness in expressing them, his life was singularly free from scientific controversies, and especially from those leading down into personalities. In many long conversations with him, I do not recall that I ever heard him express a personal dislike for a scientific colleague, except in one case where he felt that advancement in a teaching position had been obtained by servility, and another where he felt that his own matured opinion had been treated rather contemptuously.

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His last years were full of honors. He was a delegate to the International Zoological Congress at Monaco; Yale University gave him an honorary D. Sc.; he was chosen to the limited membership of the National Academy of Sciences, and the Entomological Society of America made him an honorary fellow, one of 7 out of its membership of 600.

He was married in 1880 to Annie I. Hathaway, of New Haven, who survives him, together with three daughters and a son.

I first knew him by correspondence in 1890, when on learning that I was beginning to work on Diptera he sent me separates of his papers. In January, 1893, I went to the University of Kansas to study, drawn entirely by his presence there. He received me with open arms, and helped me in every way possible until I left in July to take up my work in Idaho. Then I saw him only a time or two in 20 years, and had few and short letters from him, for he was a notably poor correspondent. After coming to Indiana in 1913 I was so near that we were frequently together. My sketch would be entirely inadequate without some acknowledgment of my personal obligation. In Kansas he lent me money; he wanted me to live in his house; he could not do enough to further my scientific aspirations. More than any other of my teachers, he became my ideal of a scientific man; and if in later years my ideal took on larger proportions, so he, too, seemed to expand in his mature powers; and at the close of his life I still feel that a splendid and inspiring example of scientific work and achievement is contained in his career.

(Extract from Entomological News, vol. 29, Nov., 1918, pp. 322–327.)

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THIRD ANNUAL REPORT OF THE NATIONAL RESEARCH COUNCIL.

The sudden collapse of the central powers, and the consequent swift transition from war to peace conditions, fortunately did not take the National Research Council wholly unawares. From the time of its initiation in 1916, the Council has always recognized that its chief service could be best performed in times of peace, and the definition of its functions contained in the Executive Order issued by President Wilson on May 11, 1918, relates particularly to this possibility. Moreover, throughout the period of the war, when all of the divisions of the Council were organizing and promoting research to meet military and naval needs and to solve industrial problems of an emergency nature, the question of future activities and the provision of an organization adequate to deal with them were constantly in view. Since the signing of the armistice the chief work of the Council has been to utilize the various preliminary studies made during the war period for the formulation of a definitive scheme of organization and a plan of work in keeping with the heavy demands which existing conditions entail.

Apart from its numerous war activities, outlined in the present report, and to be treated subsequently in greater detail, the leading matters of interest in the progress of the Council during the past year are the Executive Order of President Wilson, the development of the work of the Research Information Service, the organization of the International Research Council, the report of the Patent Committee, the work of the Industrial Research Section, and the preparation of a plan of permanent organization. Before dealing with the reports of divisions on war problems, these phases of the Council's activities will be described.

THE PRESIDENT'S EXECUTIVE ORDER.

The congressional charter of the National Academy of Sciences provides that "the Academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art." Under this provision the Academy has acted since the time of its establishment as an official adviser of the Government on a wide variety of questions. During the Civil War, as the earlier records of the Academy indicate, its com-

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mittees and its members dealt actively with military and naval problems of precisely the same type as those which have insistently pressed for solution during the present war. It was thus a natural step on the part of the Academy to offer its services to the President at a time, in April, 1916, when our relations with Germany were already tense, and for the President to accept the offer, and to request the Academy to organize the scientific and technical resources of the country in the broadest and most effective manner, to accomplish the objects in view. He recognized clearly, as the Academy also had perceived, that new and important possibilities had been opened through the heavy demands upon science and research which had arisen through the exceptional necessities brought about by the war.

In accepting the President's request, and in taking the steps that soon led to the establishment of the National Research Council, the Academy, fortified by its charter, waited for no more formal expression than that conveyed by the President's oral statement. But as the work of the Research Council progressed, it became evident that a definite formulation of its objects by the President, and an expression of his desire that it be perpetuated by the Academy and permanently assured of the cooperation of the various departments of the Government, would serve a useful purpose. The President's recognition of this fact led him to issue the following Executive Order on May 11, 1918:

NATIONAL RESEARCH COUNCIL.

EXECUTIVE ORDER ISSUED BY THE PRESIDENT OF THE UNITED STATES.

The National Research Council was organized in 1916 at the request of the President by the National Academy of Sciences, under its congressional charter, as a measure of national preparedness. The work accomplished by the Council in organizing research and in securing cooperation of military and civilian agencies in the solution of military problems demonstrates its capacity for larger service. The National Academy of Sciences is therefore requested to perpetuate the National Research Council, the duties of which shall be as follows:

1. In general, to stimulate research in the mathematical, physical, and biological sciences, and in the application of these sciences to engineering, agriculture, medicine, and other useful arts, with the object of increasing knowledge, of strengthening the national defense, and of contributing in other ways to the public welfare.

2. To survey the larger possibilities of science, to formulate comprehensive projects of research, and to develop effective means of utilizing the scientific and technical resources of the country for dealing with these projects.

3. To promote cooperation in research, at home and abroad, in order to secure concentration of effort, minimize duplication, and stimulate progress; but in all cooperative undertakings to give encouragement to individual initiative, as fundamentally important to the advancement of science.

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4. To serve as a means of bringing American and foreign investigators into active cooperation with the scientific and technical services of the War and Navy Departments and with those of the civil branches of the Government.

5. To direct the attention of scientific and technical investigators to the present importance of military and industrial problems in connection with the war, and to aid in the solution of these problems by organizing specific researches.

6. To gather and collate scientific and technical information at home and abroad, in cooperation with governmental and other agencies, and to render such information available to duly accredited persons.

Effective prosecution of the Council's work requires the cordial collaboration of the scientific and technical branches of the Government, both military and civil. To this end representatives of the Government, upon the nomination of the President of the National Academy of Sciences, will be designated by the President as members of the Council, as heretofore, and the heads of the departments immediately concerned will continue to cooperate in every way that may be required.

WOODROW WILSON.

THE WHITE HOUSE, *May 11, 1918.*

Supplementing, as it does, the charter of the Academy, and serving as a permanent request for the exercise of such functions as the National Research Council has been able to render, this Executive Order points the way for the future work of the Council.

RESEARCH INFORMATION SERVICE.

One of the functions of the Research Council, as stated in the Executive Order, is "to survey the larger possibilities of science, to formulate comprehensive projects of research, and to develop effective means of utilizing the scientific and technical resources of the country for dealing with these projects." The Research Information Service, inaugurated in cooperation with the Intelligence Services of the Army and Navy, and represented in London, Paris, and Rome by scientific attachés and their associates connected with the American embassies, is the first requisite in preparing such broad surveys. Properly regarded, this Information Service may be considered as the pioneer corps of the Council, surveying the progress of research in various parts of the world, selecting and reporting upon many activities of interest and importance, reducing the information thus collected to such a form as to render it most accessible and useful, and disseminating it to scientific and technical men and to institutions which can use it to advantage.

But the work of the Service must not end here. Its duties necessarily involve the collection of much detailed information; but to accomplish the larger objects of the Council its attention must not be confined solely to matters of detail. Out of this great mass of information, and out of the work of the various divisions of the Council, acting in cooperation with the Research Information Service,

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there must come broad surveys of the larger possibilities of research, indicating opportunities likely to be missed by the investigator concerned with limited branches of science, and pointing the way to the occupation of many fields where great return may be expected to result from well-organized effort.

It therefore goes without saying that the position of scientific attaché at our principal embassies, created during the war in connection with the Research Information Service, should undoubtedly be continued during times of peace. The scientific attaché acts in conjunction with the military and naval attachés, who are glad to intrust him with many of their technical problems. Such problems will frequently arise in the future as they did in the period preceding the war. But the duties of the scientific attaché are evidently not confined to questions of war, which, indeed, can not be distinguished in most cases from the problems of peace. Nitrates, no longer needed for explosives, are now no less urgently demanded for fertilizers. Optical glass, if not required for gun sights and periscopes, is wanted in large quantities for field glasses, microscopes, medical instruments, and scores of other purposes. Metallurgical processes, improved for the manufacture of guns and helmets, must give us flawless rails for security in travel, better electrical conductors, and other essentials. In short, almost all of the subjects in which the scientific and technical men of the allies have exchanged research information during the war demand similar cooperation under peace conditions. In view of these facts, the International Research Council, at its first meeting in Paris, adopted the following resolution:

The International Research Council, assembled in Paris and attended by delegates of the national academies of sciences of Belgium, Brazil, the United States, France, Great Britain, Italy, Japan, Poland, Portugal, Rumania, and Serbia, has the honor to request the Governments of these countries to appoint permanent scientific attachés at their principal embassies. The function of the scientific attachés shall be to collect and forward information regarding scientific and technical matters, and to insure the continuity of the relations established during the war by the various scientific and technical missions.

In addition to the services already mentioned, the scientific attaché would serve as the general representative of American scientific and technical interests in the country to which he may be accredited; attend scientific meetings and keep in touch with the progress of research, reporting frequently to Washington; maintain his office as a center for American scientific and technical men and missions desiring to make contact with the scientific men or institutions of the country; undertake special tasks and make particular reports on questions submitted by properly accredited individuals or institu-

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tions; and contribute in other ways toward international cooperation in research.

On December 8, 1917, the military committee of the National Research Council adopted resolutions providing for the creation of the Research Information Committee and outlining its functions. These resolutions were submitted to the National Research Council for approval and for transmission to the Council of National Defense. On December 12, the Council of National Defense approved the project, and Dr. S. W. Stratton was appointed chairman of the committee, which included the Chief of Military Intelligence and the Director of Naval Intelligence. The organization proceeded rapidly from that time. An appropriation of $38,000 was made from the President's fund to cover the first year's expenses of the Washington, London, and Paris offices, and Dr. H. A. Bumstead and Dr. W. F. Durand sailed early in February to assume their duties as scientific attachés at the London and Paris embassies, respectively. Early in May, the Italian Ambassador addressed a request from his Government to the Secretary of War, asking that an office of the Research Information Committee, similar to those in London and Paris, be established in Rome. After some delay this was authorized, and an additional appropriation was made to cover the expense of the new office. Mr. S. L. G. Knox was appointed scientific attaché at Rome by the chairman of the National Research Council, and sailed in July to assume his duties there.

After the successful operation of the committee for several months, it began to appear that expansion of the organization was desirable, and the following order was issued by the Secretary of War on July 2, directing that an officer from each of the military bureaus be appointed to represent his respective bureau on the committee.

WAR DEPARTMENT,
THE ADJUTANT GENERAL'S OFFICE,
Washington, July 2, 1918.

From: The Adjutant General of the Army.
To: The National Research Council, Washington, D. C.
Subject: Information section, Ordnance Department, and Research Information Committee.

1. The Secretary of War directs that you be informed as follows:

2. The Research Information Committee was formed to establish machinery by means of which the General Staff of the Army, the various bureaus of the Army and Navy, the scientific organizations in the United States who are working on problems connected with war production and invention, and the various committees of the Council of National Defense charged with work of this nature, may be put in touch with the developments and experimental work being carried on, not only in this country but in Europe, and kept mutually informed of the state of development of work of this nature.

3. In pursuance of the order of the Secretary of War, establishing this committee and in order effectively to do this work, it is vitally necessary that the

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utmost of cordial cooperation be shown by each of the bureaus and committees in question with the Research Information Committee. To secure this the following is directed:

(*a*) All military bureaus requiring scientific and technical information are given official status on the Research Information Committee in Washington, D. C.

(*b*) Representatives of military bureaus or of research committees collecting information abroad will be instructed, by their chiefs, to put themselves into direct relationship with the joint committees of the Research Information Committee sitting in Paris or London, or later in Rome, in order that information be at once dispatched to the Research Information Committee at Washington, D. C. All communications of scientific investigations or research shall be routed through these channels, even though other channels are employed at the same time.

(*c*) Official means of intercommunication, such as memorandums, bulletins, and the like, between bureaus of the Army and committees for research shall be developed to such a degree of efficiency by the Research Information Committee that the distribution of information shall be practically automatic.

(*d*) Before sending officers or civilians abroad for investigation work, all Army bureaus or civilian research committees shall get in touch with the Research Information Committee at Washington, D. C., for information and guidance.

(*e*) The present method of routing information memoranda for file and distribution through the Military Intelligence Branch will not be discontinued.

(*f*) You will immediately notify this office and the Research Information Committee of the name of the officer who shall represent your bureau before the Research Information Committee.

BY ORDER OF THE SECRETARY OF WAR:

(Sgd.) PAUL GIDDINGS, *Adjutant General.*

In accordance with the principles of this order of the Secretary of War, the Research Information Committee was reorganized and its name changed to the Research Information Service. In addition to the military representatives appointed in accordance with the order of the Secretary of War, representatives of naval bureaus and of certain civil bureaus of the Government were also appointed. The new organization which thus resulted may be found on page 103.

The work of the Washington office of the Service during the war included the sending of scientific and technical information to our scientific attachés abroad, the distribution of reports from foreign offices, the cataloguing and filing of reports, and such miscellaneous services as the introduction to our scientific attachés abroad of officers and civilians going to Europe to collect information, and the utilization of various means of making the information collected of general use to the Army and Navy and to other agencies engaged in the investigation of war problems. In addition to the numerous reports and the other information sent abroad, various special pieces of apparatus have been secured and forwarded in answer to specific requests, including a complete device for the training of gun pointers, sets of special signalling apparatus, vacuum apparatus required by the British Ministry of Munitions, and numerous small articles, such

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as luminous zinc sulphide, special aviators' goggles, ear valves, Aldis sights, camera mountings, etc.

One of the most important phases of the work of the Washington office has been the distribution of reports received from the foreign offices. The nature of these reports has been extremely varied, covering practically every field of activity on war problems. To indicate some of the subjects included, and also to illustrate the fact that many of these reports are on subjects which are quite as important under peace conditions as during the time of war, the following summary will be of interest:

	Reports from abroad.	Index cards (approximately).
Aeronautics:		
Airplanes	330	2,000
Balloons, dirigibles	54	350
Ordnance:		
Antiaircraft	30	150
Bombs	44	350
Explosives	32	240
Miscellaneous	26	200
Submarine detection	116	600
Toxic gas warfare	20	400
Location by sound	38	160
Signaling	22	200
Camouflage	17	100
Chemistry	106	400
Metals	72	360
Photography	29	250
Medical	21	200
Radio	15	320
Gasoline engines	21	160
Searchlights	11	150
Optical miscellaneous	14	100
Miscellaneous	83	1,000
Total	1,101	7,690

Much of the information included in the last half of this table, and many of the reports relating to aeronautics, are of value for peace purposes as well as for those of war.

Most of these reports have been either "confidential" or "secret," and their distribution has entailed the greatest care on the part of the office personnel. The obvious idea has been that these reports should be received by all persons in the Government service officially concerned in them, and that they should not be sent to persons not properly concerned in them. As the number of reports received from abroad increased it was found desirable to inaugurate a limited circulation of confidential memoranda containing titles of the reports

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received, together with a brief statement of the nature and content of the reports. Subsequent to the reorganization of the Research Information Service, copies of these memoranda, complete from the beginning, were sent to each official representative of military, naval, and civil bureaus, and these were supplemented regularly by the issue of memoranda relating to new reports. With the aid of such memoranda each bureau was informed of the existence and nature of reports in which they might be officially interested and which might not have reached them from other sources. Copies of the full reports were then furnished on request of the bureaus. In this way nearly 1,200 copies of reports, many of them of considerable length, have been prepared and distributed.

The numerous activities of the foreign offices of the Research Information Service, unfortunately, can not be reported upon in detail here, but more complete information regarding them will be given later. No mention of these offices can be made, however, without an expression of our appreciation of the cordial cooperation of our embassies, of the naval and military officers of the American forces, and of all representatives, military, naval, and civil, of the British, French, and Italian Governments. The extremely cordial attitude of Admiral Sims, in command of United States naval forces operating in European waters, is best illustrated by the following order, creating a scientific division of his staff, placing the scientific attaché in London at its head, and calling for the full cooperation of the officers connected with our vessels abroad:

UNITED STATES NAVAL FORCES OPERATING IN EUROPEAN WATERS,
U. S. S. "MELVILLE," FLAGSHIP,
London, England, April 16, 1918.

CIRCULAR LETTER NO. 21.

Subject: Joint Information Committee.

1. Since the beginning of the present war, and particularly since the entry of the United States into the war, various departments of the Government, associations, societies, and clubs throughout the United States have sent representatives abroad for scientific and industrial research work, each department or other body acting independently and without reference to what the others were doing.

2. This practice has caused a considerable duplication of work, given great annoyance to those from whom the information has been obtained abroad, and has resulted in friction, inefficiency, and failure to achieve the most satisfactory results.

3. To correct this unsatisfactory state of affairs the Secretaries of War and of the Navy, by joint action, and with the approval of the Council of National Defense, authorized and approved the organization, through the National Research Council, of a joint information committee, to have its headquarters in Washington and to have branch committees in London and Paris. The branch committees are intended to work in close cooperation with the officers of the Military and Naval Intelligence Services.

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4. The functions of the branch committees in London and Paris are to secure, classify, and disseminate scientific, technical, and industrial research information (particularly such as relates to war problems) and to effect the interchange of such information between the allies in Europe and the United States.

5. The State Department has agreed to withhold passports from all scientific investigators except from those applicants who are duly recommended for passports by the joint information committee in Washington. It is the intention of that committee, before recommending the issue of a passport, to investigate carefully the necessity for the proposed research work, making sure that the information sought is not already on file and that the organization abroad is not in a position to obtain such information with its previously existing personnel.

6. All such investigators who are granted passports are to be regarded as representatives of the joint information committee and will be directed to report to the London committee upon arrival in England and to the Paris committee on arrival in France.

7. The joint committee sitting in Washington consists of the following:

(1) A civilian member, representing the National Research Council.

(2) The chief of the Military Intelligence Section.

(3) The director of Naval Intelligence.

8. The initial organization of the branch committees in London and Paris will be:

(1) A scientific attaché, representing the joint information committee.

(2) The chief of the Military Intelligence Section.

(3) The director of Naval Intelligence.

9. The scientific attachés at present are: London, Dr. H. A. Bumstead; Paris, Dr. W. F. Durand. Assistants to these attachés will presumably be sent from the United States from time to time, as the need for them becomes apparent. At present Mr. S. W. Farnsworth is at the London office as an assistant to Dr. Bumstead.

10. The chief functions of the branch committees are intended to be the following:

(*a*) The development of contact with all important research laboratories or agencies, governmental or private; the compilation of problems and subjects under investigation; and the collection and compilation of the results attained.

(*b*) The classification, organization, and preparation of such information for transmission to the joint information committee in Washington.

(*c*) The maintenance of continuous contact with the work of the offices of military and naval attachés in order that all duplication of work or crossing of effort may be avoided, with the consequent waste of time and energy and the confusion resulting from crossed or duplicated effort.

(*d*) To serve as an immediate auxiliary to the offices of the military and naval attachés in the collection, analysis, and compilation of scientific, technical, and industrial research information.

(*e*) To serve as an agency at the immediate service of the commander in chief of the military and naval forces in Europe for the collection and analysis of scientific and technical research information, and as an auxiliary to such direct military and naval agencies as may be in use for the purpose.

(*f*) To serve as centers of distribution to the American Expeditionary Forces in France and to the American Naval Forces in European Waters of scientific and technical research information originating in the United States and transmitted through the joint information committee in Washington.

(*g*) To serve as centers of distribution to our allies in Europe of scientific, technical, and industrial research information originating in the United States and transmitted through the joint information committee in Washington.

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(*h*) The maintenance of the necessary contact between the officers in London and Paris, in order that provision may be made for the direct and prompt interchange of important scientific and technical information.

(*i*) To aid research workers or collectors of scientific, technical, and industrial information from the United States, when properly accredited from the joint information committee in Washington, in best achieving their several and particular purposes.

11. The scientific attaché in London, with his assistants, has been given office space and facilities at the force commander's London headquarters, and is regarded as a member of the force commander's staff. It is desired and directed that all officers of the staff facilitate in every possible way the performance of the work of the scientific attaché, and that they keep him informed as to the classes of information or scientific investigation that would be most beneficial to them in their work.

12. Officers in the force at large are desired to furnish to the scientific attaché, through the force commander, any information of value of which they may be possessed and to make suggestions as to profitable lines of scientific investigation.

13. The branch committee in London, or the scientific attaché, as its representative, in distributing information as contemplated in paragraph No. 10 (*f*) above, will do so through the medium of the force commander as regards the naval forces and through such channels as the military attaché may prescribe as regards the military forces. The branch committee in Paris will forward information to the naval forces through the naval attaché, who will transmit it through the usual official channels.

14. In distributing information to our allies in Europe, as contemplated in paragraph No. 10 (*g*) above, the branch committees, or the scientific attachés as their representatives, will transmit the information through the military or naval attaché if it is intended for the military or naval departments of the foreign governments concerned; if it is intended for a civil department, it will be transmitted direct, but if it would be of use or interest to the military and naval forces it will be also transmitted to the military and naval commanders through the attachés.

15. In order to facilitate the work of the branch committees under paragraph No. 10 (*i*) above, it is desired and directed that the officers of the force commander's staff exert every proper effort to make sure that all investigators, whether officers or civilians, who come to London are put in touch with the scientific attaché in order that mutual assistance may be rendered and that a complete file of information may be maintained in the branch committee's office. All officers of the staff are furthermore directed, before initiating any new investigation, to consult with the scientific attaché to determine whether or not the desired information has been already acquired by the branch committee, and they will equally inform the scientific attaché of the results of any investigations they may make. All concerned must constantly bear in mind the necessity for avoiding duplication of work on the part of the various branches of the staff organization.

16. Officers attached to headquarters in Paris will be guided by the principles underlying the instructions contained in the preceding paragraphs.

(Signed) WM. S. SIMS,

Vice Admiral, U. S. Navy, Commanding and Naval Attaché, London.

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OFFICE MEMORANDUM NO. 61.

LONDON, *April 16, 1918.*

Subject: Scientific attaché.

1. The attention of all the staff is invited to Circular Letter No. 21, of April 16, 1918, regarding the joint information committee organized in Washington, with branch committees in London and Paris, and the scientific attachés.

2. While all officers are desired to keep in as close touch as possible with the work of the scientific attaché, it is particularly desirable that the following officers maintain the closest relations with him with a view to constant interchange of information:

(1) The officer having cognizance of submarine hunting by sound.
(2) The ordnance officer.
(3) The radio officer.
(4) The officer having cognizance of electrical matters.
(5) The medical officer.

3. The division of the staff headed by the scientific attaché will be known as the Scientific Division, and its symbol will be NS.

(Signed) N. C. TWINING,
Captain, U. S. Navy, Chief of Staff.

In addition to the advantages thus accorded to our scientific attachés, Admiral Sims furnished them with offices in both London and Paris, and contributed in many other ways to the convenience and efficiency of their work. Maj. Gen. John Biddle, commanding the American Expeditionary Forces in England, also issued a similar order and facilitated in many other ways the work of the scientific attaché. Similar courtesies were shown to our representatives in Paris and Rome, both by the Army and Navy. It thus appears that the cooperative plan involved in the organization of the Research Information Service has proved to be acceptable to all of the interests concerned, and that its continuation should be advantageous after such modifications have been made as will be necessary to render the service of the greatest use under peace conditions.

One of the chief objects now to be attained is to render the offices of the Service more effective as centers of information on scientific and technical questions. Existing agencies of such information, such as Government bureaus and the valuable library service of the American Society of Mechanical Engineers in New York, will be freely drawn upon. It is not the intention to duplicate such sources, but to secure their wider utilization. In addition to the fund of information available in its own offices, the Research Information Service will arrange to call upon competent correspondents in scientific and technical laboratories throughout the country, who will aid in supplying special information.

The work of organizing the Information Service for its new and larger duties is now proceeding under the direction of Dr. Robert M. Yerkes and with the assistance of Dr. G. S. Fulcher, who replaced Dr. Graham Edgar when the latter resigned his position on January

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27, 1919, after conducting the office with marked success throughout the greater part of the war.

ORGANIZATION OF THE INTERNATIONAL RESEARCH COUNCIL.

On June 17, 1918, the secretary of the Royal Society of London invited the National Academy to send delegates to an Interallied Conference on International Scientific Organizations, to open in London on October 9. The president of the Academy, after the matter had been given full consideration by the council of the National Academy of Sciences and the executive board of the National Research Council, appointed the following delegates from the Academy and Council: H. A. Bumstead, J. J. Carty, W. F. Durand, Simon Flexner, A. A. Noyes, and George E. Hale, chairman. All of these attended the conference in London, at which the following countries were represented by the delegates named below:

Belgium.—Georges Lecointe, J. Massart, Ch. de la Vallée Poussin.

Brazil—C. D. de Carvalho.

France.—B. Baillaud, G. Bigourdan, Albin Haller, A. Lacroix, Charles Lallemand, Charles Moureu, Emile Picard.

Italy.—Vito Volterra.

Japan.—Joji Sakurai, Aikichi Tanakadate.

Portugal.—Braamcamp Freire.

Serbia.—B. Popovitch.

United States.—H. A. Bumstead, J. J. Carty, W. F. Durand, S. Flexner, G. E. Hale, A. A. Noyes.

Great Britain.—Sir J. J. Thomson, Sir Alfred Kempe, A. Schuster, W. B. Hardy, W. A. Herdman, Sir F. Dyson, J. H. Jeans, H. G. Lyons, J. A. McClelland, Sir E. Sharpey Schafer, C. S. Sherrington, Sir W. Tilden.

The delegate nominated by the Government of Portugal did not arrive in England in time to take part in the conference.

A committee of the Royal Society issued a memorandum on international scientific organizations, in which it is pointed out that they "may be divided into four groups, according to their objects and methods of procedure. Some are intended to establish uniformity in the standards of measures, others to advance science by cooperation, and others again merely to encourage present interchange of opinion. Those that aim directly at organizing scientific progress may further be divided into two parts, according as the cooperation is essential to coordinate observations taken in different places or aims only at economy of labor." The memorandum then goes on to review the characteristics of a large number of international organizations and concludes with a statement of the following subjects for discussion at the conference:

1. Is it desirable for the allied nations to establish organizations for scientific cooperation among themselves?

2. If this be agreed upon, what should be the particular forms of organisation to be aimed at in geodesy, seismology, meteorology, etc.?

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3. Should particular academies be asked to submit proposals on those undertakings in which they have taken the leading part, such as—

(*a*) The Académie des Sciences on the Commission Metrique and the Bureau International des Poids et Mesures.

(*b*) The Royal Society on the International Catalogue of Scientific Literature.

4. What representation should be addressed to the governments with regard to those organizations which have hitherto received their support?

DECLARATION.

The first act of the London conference was to define its attitude, as expressed in the following declaration, toward the question of future relations with the men of science of the central powers:

When more than four years ago the outbreak of war divided Europe into hostile camps, men of science were still able to hope that the conclusion of peace would join at once the broken threads and that the present enemies might then once more be able to meet in friendly conference, uniting their efforts to advance the interests of science. For ever since the revival of learning in the middle ages the prosecution of knowledge has formed a bond strong enough to resist the strain of national antagonism. And this bond was strengthened during the latter part of last century, when branches of science developed requiring for their study the cooperation of all the civilized nations of the world. International associations and conferences rapidly multiplied and the friendly intercourse between the learned representatives of different countries grew more intimate in spite of their political differences, which were admitted but not insisted upon.

In former times war frequently interrupted the cooperation of individuals without destroying the mutual esteem based on the recognition of intellectual achievements; peace then soon effaced the scars of a strife that was ended. If to-day the representatives of the scientific academies of the allied nations are forced to declare that they will not be able to resume personal relations in scientific matters with their enemies until the central powers can be readmitted into the concert of civilized nations, they do so with a full sense of responsibility and they feel bound to record the reasons which have led them to this decision.

Civilization has imposed restrictions on the conduct of nations which are intended to serve the interests of humanity and to maintain a high standard of honor, such as the recognition of the sanctity of treaties, especially those designed to apply to a state of war, and the avoidance of unnecessary cruelties inflicted on civilians. In both these respects the central powers have broken the ordinances of civilization, disregarding all conventions, and unbridling the worst passions which the ferocity of war engenders. War is necessarily full of cruelties; individual acts of barbarity can not be avoided and have to be borne. It is not of these we speak, but of the organized horrors encouraged and initiated from above with the sole object of terrorizing unoffending communities. The wanton destruction of property, the murders and outrages on land and sea, the sinking of hospital ships, the insults and tortures inflicted on prisoners of war, have left a stain on the history of the guilty nations which can not be removed by mere compensation of the material damage inflicted. In order to restore the confidence without which no scientific intercourse can be fruitful, the central powers must renounce the political methods which have led to the atrocities that have shocked the civilized world.

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INTERNATIONAL RESEARCH COUNCIL.

On behalf of the council of the National Academy of Sciences, the delegates of the Academy submitted to the conference the following proposal:

SUGGESTIONS FOR THE INTERNATIONAL ORGANIZATION OF SCIENCE AND RESEARCH.

1. Immediate importance of International Organization to meet war needs.—The experience of men of science since the outbreak of the war has strongly emphasized the fact that there has never been an international association adequate to represent the larger interests of science and research. The International Association of Academies had within it the germs of better things, and some of us have attended its meetings for years in the hope that it might ultimately be developed into a thoroughly effective organization. Its chief merit lay in the inclusion of the principal national academies of sciences, which should certainly play a leading part in any international organization relating to science as a whole. Its defects were more numerous, involving among others the exclusion of many elements vital to the promotion of the best interests of research, together with an almost complete cessation of activity during the three-year intervals between successive meetings. Since the Petrograd meeting of 1913, when the possibility of greater usefulness was freely discussed, the association has practically ceased to exist.

Current events clearly indicate, however, the great importance of establishing an international body for promoting the general interests of science and research. The special needs of geodesy, chemistry, engineering, seismology, medicine, astronomy, and other branches of science and technology are no less urgent than before, and the various international bodies formed to deal with them should be reorganized to meet existing conditions. But the broader necessities of science and research, seriously threatened through loss of men and curtailment of revenue, but potentially strengthened through a greatly enhanced public appreciation of their national importance, call for a new and vigorous movement in their behalf. This should be initiated at once by the nations of the Entente, primarily with reference to war needs, but with the expectation that in the future other nations, not now in a position to cooperate, will be invited to take part.

2. New factors in the organization of research emphasized by recent experience.—Experience in the United States since our entrance into the war has emphasized the following facts:

1. The essential solidarity of scientific research in all of its aspects and the ease with which investigators hitherto concerned only with pure science can deal with military and industrial problems.

2. The necessity of establishing and maintaining close cooperation between investigators formerly separated into academic, industrial, and military groups, and the immediate advantage to the nation which such cooperation has afforded.

3. The increased sense of obligation to the state on the part of all men of science and their strengthened desire to render their researches of the widest possible value.

4. The advantages certain to result in pure science from closer and more active cooperation between investigators who have specialized in its several fields, and from their contact with military and industrial problems.

5. The urgent necessity of strengthening the nation and compensating in part for the losses of war by the development of the industries through research.

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6. The recognition by far-sighted industrial leaders of their obligations to pure science, and their desire to assist in providing adequately for its future support and development.

7. The importance of taking immediate advantage of the present opportunity to promote the interests of science and research.

The proposed scheme of international organization is suggested as a means of utilizing the above facts to the advantage of science and technology, and for the mutual welfare of the nations of the entente. It is based on plans for the national organization of research, which must be presented first.

3. Establishment of national research organizations.—The national organization in each contracting State should be headed by the corresponding national academy of sciences, because of its close connection with the Government, its inclusion of the entire realm of the mathematical, physical, and biological sciences, and its previous international activities in the interest of science as a whole.

In view of the limited membership or scope of the several national academies, and the importance of including in the organization the most active leaders of research of each country, whether academy members or not, the following procedure is recommended: Let each national academy establish a research council, resting upon the charter of the academy and thus sharing in its national prestige and its relationship to the Government. These councils should be organized with the cooperation of the leading national societies interested in the promotion of research in the mathematical, physical, and biological sciences, and their applications in engineering, medicine, agriculture, and other useful arts. The membership of such research councils should comprise representatives of three principal groups: The heads and leading investigators of the scientific and technical services of the Government, both military and civil; active research workers in educational institutions and research foundations; and leaders of research in engineering, medicine, agriculture, and the industries. This membership should change from time to time in order to bring in fresh stimulus and ideas from all parts of the country, and to secure the advantages of cooperation with men of the widest range of interest. The council should have the active support of the best-known leaders of industry, whose indorsement of its purposes would weigh more heavily with the general public than that of men not identified with practical affairs.

Such an organization, in direct contact with the military and economic problems of the Government and the needs of science and research in educational institutions, in the industries, and in connection with many aspects of the public welfare, should be far more effective than any body more narrowly conceived. Necessities resulting from the war will force extensive efforts to overcome losses sustained in every field. So long as they are opposed by dangerous enemies, the nations of the Entente must develop their methods of defense by means of scientific research. We can no longer afford to depend solely upon foreign sources of supply, but must utilize research in order to meet our many needs for nitrates, dyestuffs, and other essential commodities. The burdens of heavy taxation must be lightened by reducing the cost of manufactured articles through research. The yield of our cultivated fields must be increased by the most scientific methods. The conditions of labor must be improved by every means that research affords. The supply of scientific investigators, sadly depleted by the war, must be made good by developing research in educational institutions. Pure science, fundamentally important to the State and not appealing directly to superficial thinkers, must be aided as never before.

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In support of all these activities, the common efforts of all who realize the importance of research, in science and in its applications, should be strongly united. Separate and unconnected movements to promote research in any field, carried out independently by men primarily concerned with pure science, industry, or medicine, lose many of the advantages which cooperation and mutual aid can supply. Thus the need in each country of a national research organization, federating all interests and preserving a just balance between the claims of science in its underlying branches and in its applications in the useful arts, would seem to be plainly indicated.

There need be no conflict between the type of organization here proposed and such bodies as the advisory councils for scientific and industrial research, recently established as government departments in England and several of the British colonies. Indeed, a working union between the British Advisory Council and the Royal Society, with the inclusion of representatives from the Admiralty, the Ministry of Munitions, the leading scientific and technical societies, and the industries, could accomplish the purposes in view. The Advisory Council would continue to exercise its present functions, while the proposed organization, federating research interests in all fields, including munitions, medicine, agriculture, fisheries, and forestry, which do not appear to lie within the scope of the advisory council, would provide the means of securing the widest cooperation and the means of utilizing in any field the principles and methods which have been developed elsewhere.

4. Establishment of an international research organization.—An international federation of such national organizations should provide the best means of meeting the general needs of science and research, and of securing the close and effective cooperation between the nations of the Entente that is essential to their future welfare.

This international body should comprise representatives of the several national research organizations and ultimately of special international associations dealing with research in engineering, medicine, agriculture, and the various branches of science and technology. A general meeting should be held annually, but a group of representatives should be constantly at work in a permanent office in London or Paris, where frequent conferences on international cooperation in research for military, industrial, or general scientific purposes would be held. Each contracting country should be officially represented at this office by members of the various technical bureaus and boards, military and civil, which are also represented in its national research organization. Means would thus be provided for a constant interchange of ideas, and close contact would be secured with research in all of its phases. Without such close cooperation we can not expect in the existing emergency to match our opponents in the development of military devices or in overcoming industrial difficulties created by the war.

At present, as indicated in the accompanying "Outline of plan for an inter-allied research council," we propose the establishment of a body especially adapted for war purposes. After the war, if it should then seem advisable, the scope of this organization may be expanded to any desired degree, even to the inclusion of history, philology, and related subjects.[1]

[1] This memorandum was prepared in the spring of 1918 and forwarded to the academies of the Entente soon afterward. At the time of the London conference it was evident that the end of the war was close at hand. The delegates of the National Academy therefore proposed that the national research councils, as well as the international body to be formed by their federation, be organized for service under peace conditions.

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After discussion by the conference, this recommendation for the establishment in each of the participating countries of a national research council, and the federation of these bodies to form an international research council, was unanimously adopted.

RESOLUTIONS ADOPTED.

The following resolutions were adopted by the conference:

1. That it is desirable that the nations at war with the central powers withdraw from the existing conventions relating to international scientific associations in accordance with the statutes or regulations of such conventions, respectively, as soon as circumstances permit; and that new associations deemed to be useful to the progress of science and its applications be established without delay by the nations at war with the central powers, with the eventual cooperation of neutral nations.

2. That certain associations, such as the metric convention, depending on diplomatic agreements, be taken into consideration during the peace negotiations.

3. It is not intended that these measures be applied to agreements relating to indispensable administrative relations between public services, such as those regulating navigation, meteorological telegrams, railways, telegraphs, etc.

4. A committee of inquiry be constituted by the conference, the academies of the countries at war with the central powers having power to add further members. This committee shall prepare a general scheme of international organizations to meet the requirements of the various branches of scientific and industrial research, including those relating to national defense. (The committee, with Prof. Schuster as acting president, will meet in Paris during the second fortnight in November.)

5. Each of the academies represented at the conference shall be invited to initiate the formation of a national council for the promotion of the researches specified in resolution 4.

6. An international council, having as nucleus the committee specified in resolution 4, shall be formed by the federation of the national councils.

7. The conference being of opinion that all industrial, agricultural, and medical progress depends on pure science, draws attention of the various governments to the importance of theoretical and disinterested researches, which after the restoration of peace should be supported by large endowments. The conference urges similarly the creation of large laboratories for experimental science, both private and national.

Resolved further:

8. That the resolutions of the conference, 1 to 7, be communicated by the academies to their respective Governments.

9. That the academies be requested to inform other learned societies in their respective countries of the resolutions adopted by the conference.

10. That the Royal Society be requested to inform, so far as possible, the bureaus of the international associations of the resolutions adopted by the conference with the request that they should take action in conformity with them.

PROPOSALS.

The following proposals were submitted by Prof. J. Massart:

1. To extend the system of international exchanges:

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(*a*) To effect a gratuitous interchange of publications having no commercial object (books, separate copies of papers, periodicals, etc.) between authors, societies, universities, museums, libraries, etc.

(*b*) To allow all scientific establishments in the allied countries to borrow books from all public libraries and to provide for gratuitous postal transmission.

2. To unify the courses of study at the universities so as to render possible—

(*a*) The exchange of students, who might then pursue their studies partly in one and partly in another country.

(*b*) The exchange of professors, perhaps including the exchange of scientific men who do not belong to the teaching profession, such as astronomical observers, librarians, curators of museums, etc.

3. To organize the publication of bibliographical works in all branches of science so as to render the allied countries independent of such works as Centralblatt, Jahresbericht. The Government should support such enterprises by subscribing to them.

M. Bigourdan submitted the following proposal:

That it is desirable to establish a uniform bibliographical notation relating to the whole extent of our knowledge in pure and applied science, philosophy, literature, etc.

And it was

Resolved, That M. Bigourdan's proposals be referred to the committee constituted under resolution 4, recommending them to their careful consideration.

And it was further

Resolved, That the proposals formulated by Prof. Massart, with the suggestions of Messrs. Volterra and Hardy, be referred to the committee contemplated under resolution 4, recommending them to their careful consideration.

The question of expulsion of enemy foreign members from scientific societies was also discussed, but as the sense of the meeting seemed to be that the declaration introducing the resolutions passed by the conference defined sufficiently the attitude of the allied academies toward the men of science of the central powers, no further action was taken.

PARIS CONFERENCE.

In accordance with the decision of the London conference, a second interallied conference was held in Paris under the auspices of the Paris Academy of Sciences from November 26 to November 29, 1918. This conference was attended by the following delegates:

Belgium.—Ch. de la Vallée Poussin, Georges Lecointe, J. Massart.

Brazil.—C. D. de Carvalho.

United States.—H. A. Bumstead, J. J. Carty, W. F. Durand, S. Flexner, G. E. Hale, A. A. Noyes.

France.—B. Baillaud, G. Bigourdan, Charles Flahault, Leon Guignard, Albin Haller, A. Lacroix, Charles Lallemand, Gabriel Lippmann, Charles Moureu, Paul Painlevé, Emile Picard, Edmond Perrier, Emile Roux.

Great Britain.—Sir F. W. Dyson, P. F. Frankland, J. H. Jeans, C. G. Knott, H. G. Lyons, E. A. Schafer, Arthur Schuster, S. Sherrington, E. H. Starling.

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Italy.—Gaudenzio Fantoli, Raffaello Nasini, Vincenzo Reina, Annibale Riccò, Vito Volterra.

Japan.—Jōji Sakurai, Aikichi Tanakadate.

Poland.—Ladislas Micklewicz.

Portugal.—Bettencourt Rodriguez.

Roumania.—Dragomir Hurmuzesco, G. Marinesco, L. Mrazec, Al. A. Soutzo.

Serbia.—Michel Petrović, J. Žujović.

RESOLUTIONS.

The International Research Council, proposed in the resolutions adopted in London, was provisionally constituted of the delegates attending the Paris conference, with the understanding that the various national research councils would take their place in the federation as soon as they are formed. An executive committee of five members, consisting of Messrs. Picard (chairman), representing France; Schuster (secretary), representing Great Britain; Lecointe, representing Belgium; Volterra, representing Italy; and Hale, representing the United States, was appointed to study in detail the questions presented to the conference and to undertake various other duties indicated in the resolutions given below:

RESOLUTIONS.

1. That the committee of inquiry referred to in article 4 of the conference of London shall temporarily assume the functions of the federation of national councils contemplated in the resolutions passed at London, and shall adopt the title of "International Research Council."

2. That each academy or Government represented on the committee of inquiry may at any time add to their delegates representatives of a national research council of the type contemplated in resolution 5 (London) or other similar body.

3. That the International Research Council at once appoint an executive committee of five members, which shall deal with all matters referred to it by the International Research Council.

4. That the executive committee shall take into consideration scientific or industrial projects of an international nature coming under the scope of resolution 4 (London), and more especially those concerning the formation of new associations, which shall be submitted to it by any academy represented at the conference or by any group of delegates either of the academies or of the National Research Councils. For this purpose the committee shall consult those bodies or persons whom it considers most suitable.

5. That the executive committee shall appoint separate special committees to consider in detail the formation of the new associations resolved upon in resolution 1 (London) in addition to those decided upon at the present meeting.

The members of these special committees need not be members of the International Research Council. Any special committee may appoint additional members by a vote in which not less than two-thirds of the total committee are favorable.

6. The executive committee shall have power to summon meetings of the International Research Council.

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7. The executive committee shall summon a meeting of the International Research Council as soon as, in their opinion, the body is in a position to assume its final form as contemplated in resolution 6 (London). The members of the executive committee shall then retire from their offices.

8. In the case of organizations which do not come within the scope of any of the committees appointed at this meeting, as well as in cases in which new organizations seem desirable, the executive committee may consult those bodies or persons whom it considers most suitable.

9. There shall be established under the direction of the executive committee an administrative bureau, which shall be responsible for the correspondence, the custody of documents, and administration.

DECLARATION OF POLICY.

The International Research Council recognizes that all great advances in science are initiated by individual efforts, and that it has become increasingly necessary to encourage these efforts. It includes therefore within its functions the task of actively encouraging all endeavors to supply the means and freedom necessary to those capable of conducting scientific researches of a high order.

Resolutions were also adopted relating to the bodies constituting the International Research Council and providing for the formation of committees to study (1) international services for the exchange of scientific publications and the loan of books and manuscripts; (2) the international use of existing laboratories and the establishment of additional ones; and (3) the preparation of a comparative examination of the university programs of the allied countries. The conference also took steps to initiate the formation of an International Astronomical Union, to deal with all such questions as have hitherto been included in the work of the Committee on the International Charter of the Heavens, the International Union for Cooperation in Solar Research, and other similar bodies; and an International Geophysical Union, dealing with geodesy, meteorology, terrestrial magnetism and atmospheric electricity, and seismology and vulcanology.

A plan for an International Chemical Council was also prepared and presented to the executive committee for consideration and action.

REPORT OF THE PATENT COMMITTEE.

In 1917 the Commissioner of Patents, with the approval of the Secretary of the Interior, requested the National Research Council to appoint a committee to investigate the Patent Office and patent system, with a view to increasing their effectiveness, and to consider what might be done to make the Patent Office a more truly national institution and more vitally useful to the industrial life of the country. This request was made by Mr. Thomas Ewing, at that time Commissioner of Patents, and subsequently a member of our Patent Committee.

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The National Research Council, in compliance with this request, appointed a Patent Committee, consisting of Dr. W. F. Durand, chairman; Drs. Leo H. Baekeland and M. I. Pupin, scientists and inventors; Drs. R. A. Millikan and S. W. Stratton, physicists; Dr. Reid Hunt, investigator in medical science; and Messrs. Frederick P. Fish, Thomas Ewing, and Edwin J. Prindle, patent lawyers. On the departure of Dr. Durand for Europe, Dr. Baekeland was appointed acting chairman of the committee.

The Patent Committee, believing the American patent system to be one of the most potent factors in the development of the prosperity of the country, and serving as a high incentive to invention and as an instigator of much of the activity which has led to the development of new methods and devices of great service in the war, has appreciated the importance of investigating the Patent Office and the patent system with special care, in the hope of increasing their effectiveness in harmony with the possibilties afforded by modern development in other fields.

As the result of an extended investigation the committee has proposed a program limited to but four features, because it believes these features to be of such fundamental importance that their enactment into law would strengthen the entire system, and directly or indirectly establish it upon a new and much more advantageous footing before Congress and the public; and because a simple program would be more likely to secure greater degree of unanimity of opinion in its support than would be possible if the program were more extended. The four proposals of the committee are as follows:

(1) The establishment of a single court of patent appeals that will have jurisdiction of appeals in patent cases from all the United States district courts throughout the country in place of the nine independent circuit courts of appeals in which appellate jurisdiction is now vested; (2) that the Patent Office be made a separate institution, independent of the Department of the Interior or of any other department; (3) a substantial increase in the force and salaries of the Patent Office; and (4) that section 4921 of the Revised Statutes of the United States be so amended as to enable the patentee in all suits where the patent has been found valid and infringed to recover at least a reasonable royalty, and to provide for a money recovery in the great majority of patent suits where no recovery would otherwise be possible.

The report of the committee, which deserves the most careful consideration by Congress, presents strong arguments in support of its proposals, and is accompanied by bills intended to carry them into effect. It will be published separately as a bulletin of the National Research Council.

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PROMOTION OF INDUSTRIAL RESEARCH.

One of the most striking consequences of the war is the increasing general realization of the primary importance of scientific research to the whole question of national defense, as well as to the successful prosecution of industry and the greatest measure of economy of resources after the war. The necessity of research work as the only means of solving many military and industrial problems raised by the war was realized by the British, who, despite the stress of war, have adopted a comprehensive scheme, under the supervision of a special committee of the Privy Council, to which Parliament has voted a sum of one million sterling. This fact in itself shows the importance which the British attach to the organization and prosecution of industrial research; and action in the same general direction has already been taken by France, Australia, Canada, and New Zealand, not to mention Germany, which has long been awake to this need.

Impressed by the great importance of promoting the application of science to industry in this country, the National Research Council took up the question of the organization of industrial research in the belief that this matter should be furthered in every way possible and as rapidly as may be, for the following reasons: In the first place, because of the necessity for rapid technical advance in many industries, if we are to compete successfully with other nations; secondly, because any steps taken in this direction will react immediately to further the general appreciation of science and of its usefulness when applied; thirdly, because the present time is conducive to the growth of new ideas—indeed, such a favorable opportunity may not recur. The matter has been very well put by Mr. Elihu Root, who, at a meeting called to discuss this general question made remarks, in part, as follows:

I have no justification for expressing views about scientific and industrial research except the sympathetic interest of an observer for many years at rather close range. One looking on comes to realize two things: One is the conquest of practical life by science; there seems to be no department of human activity in which the rule-of-thumb man has not come to realize that science, which he formerly despised, is useful beyond the scope of his own individual experience. The other is that science, like charity, should begin at home, and has done so very imperfectly. Science has been arranging, classifying, methodizing, simplifying everything except itself. It has made possible the tremendous modern development of the power of organization which has so multiplied the effective power of human effort as to make the differences from the past seem to be of kind rather than of degree. It has organized itself very imperfectly. Scientific men are only recently realizing that the principles which apply to success on a large scale in transportation and manufacture and general staff work apply to them; that the difference between a mob and an army does not depend upon occupation or purpose but upon human nature; that the effective power of a great number of scientific men may be increased by organization just as the

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effective power of a great number of laborers may be increased by military discipline. * * *

Under the international competitions of peace * * * the same power of science which has so amazingly increased the productive capacity of mankind during the past century will be applied again, and the prizes of industrial and commercial leadership will fall to the nation which organizes its scientific forces most effectively.

The National Research Council considers that cooperation between capital, labor, science, and management constitutes the best general means of financing and directing the extended laboratory investigations and the large-scale experimental and developmental work required for adequate industrial research. Accordingly it inaugurated an Industrial Research Section to consider the best methods of achieving such organization of research within an industry or group of related industries—e. g., industries using the same raw materials or with similar waste products. A report of the work of this Section may be found on page 64.

FINANCIAL SUPPORT.

As stated in the last Annual Report of the Research Council, its financial support at the outset was derived from a few personal contributions and from the action of the Engineering Foundation, which placed its secretary at the services of the Council and devoted its income to the Council's work. The action of the Chief Signal Officer in requesting the Council to organize the Science and Research Division of the Signal Corps, and in providing appropriations for the support of its work, afforded the means of conducting much research primarily useful to the Signal Corps and Aircraft Production Board, but also of great value to other branches of the service. Large funds for the general purposes of the council were not forthcoming, however, until the Carnegie Corporation made on June 6, 1917, an initial appropriation of $50,000, which was followed by an additional appropriation of $100,000 from the same source on May 20, 1918. The Rockefeller Foundation also recognized the possibilities of the Council's work in organizing research, and on February 27, 1918, appropriated $50,000 for the work of the Division of Medicine and Related Sciences. The Council is also indebted to Dr. W. W. Keen for a gift to the Division of Medicine and Related Sciences of $483.57, the royalties of his book entitled "The Treatment of War Wounds." Special grants from both the War and Navy Departments were made to cover the expenses of various investigations organized by the Council, and on January 7, 1918, the President authorized a grant of $29,250 from his special fund, through the Council of National Defense. The second important appropriation from the President's fund was the sum of $38,400, to provide for the initial work of the Research Infor-

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mation Committee. Subsequent grants were also made by the President to provide for the organization of our office in Rome and for other expenses of the Council. The last grant from this source was authorized on September 11, 1918, and provided $61,000 for the expenses of the Research Information Service and general expenses of the council during the first six months of 1919.

Of these appropriations to the Council, those which were available for use during the fiscal year ending June 30, 1919, are as follows:

Carnegie Corporation	$100,000.00
W. W. Keen	483.57
Rockefeller Foundation	[1] 50,000.00
President's fund	122,000.00
	272,483.57

The disbursement of these funds is shown in the treasurer's report, which is appended.

The conclusion of the war, and the necessity of providing ample funds for the continuation of the Council's work under peace conditions have led to a careful consideration of the best means of securing financial support in the future. The Rockefeller Foundation has made an additional appropriation of $15,000 for the work of the Division of Medicine and Related Sciences, and the Bell Telephone System, at the request of Mr. Theodore Vail, has guaranteed $25,000 per year toward the expenses of the Council on condition that $250,000 per year for five years be secured. It is hoped that the efforts which are now being made to obtain funds from private sources, and also to secure further appropriations from the Government for the Research Information Service and for other activities of the Council, will soon meet with success.

PERMANENT ORGANIZATION.

Much time has been devoted during the year, especially since the signing of the armistice, to the preparation of a permanent scheme of organization for the Council. During the absence of the chairman in Europe, the acting chairman, Dr. John C. Merriam, requested each of the divisions of the Research Council to give special consideration to this problem. The results of their studies have been utilized by a special committee in preparing a plan of organization which has been further developed by the executive board of the Research Council and the Council of the National Academy.

The scheme of organization in divisions, which group together representatives of related branches of science and technology, has proved so satisfactory during the period of the war that it will be continued, with such minor modifications as appear desirable. The

[1] The unexpended portion of this grant reverted to the Rockefeller Foundation on Dec. 31, 1918.

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principle of rendering the Council an effective federation of the leading research agencies of the country will be perfected through the provision that the majority of the members of each division shall consist of representatives of leading national scientific and technical societies. Thus the Engineering Division, already partially constituted under the new plan of organization, includes representatives of the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the Western Society of Engineers, the American Society for Testing Materials, the Society of Automotive Engineers, and the Illuminating Engineering Society, to which representatives of other societies and research organizations will be added in the future. The Divisions of Physical Science, of Chemistry and Chemical Technology, of Geology and Geography, of the Medical Sciences, of Biology and Agriculture, and of Anthropology and Psychology will be similarly constituted of the representatives of the leading national societies in these subjects, together with certain members at large, so chosen as to render the membership of each division best adapted to secure effective cooperation in its field. Representatives of the Government will be appointed by the President of the United States, as heretofore, and the heads of the scientific and technical bureaus of the Army and Navy and of the civil departments, grouped together in the Government Division of the Council, will be in a position to arrange for cooperation between these bureaus. Such representatives, together with those drawn from universities and research foundations and from industrial laboratories, will constitute a thoroughly comprehensive organization of the research interests of the country.

But the Research Council is something very different from a scientific society, holding occasional meetings for the reading of papers. Each of its divisions meets frequently, and during the intervals between these meetings the work of the division is conducted by a chairman, resident in Washington during his term of office, together with a vice chairman and a small executive committee. In addition there are the permanent officers of the council, who devote their whole time to its work and maintain its continuity. More complete details may be found in the appended plan of organization as finally adopted by the Executive Board of the Council and by the Council of the National Academy of Sciences (p. 109).

REPORTS OF DIVISIONS.

DIVISION OF GENERAL RELATIONS.

ARTHUR A. NOYES, *Chairman.*

Foreign Relations.—The Foreign Relations Section has hitherto consisted of the chairman of the Council and a few members who have

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given special attention to international questions. Its chief work has been the study of plans for international organization which have taken definite form in the establishment of the International Research Council and in the initiation of some of the special international bodies which are to be associated with it. The section will soon be established as the Division of Foreign Relations under the new scheme of organization, and will then include representatives of the leading international scientific and technical associations in which the United States takes part.

Industrial Relations.—In pursuance of the general plan mentioned on a previous page, the Research Council formed an advisory committee composed of men able to foresee the general benefits which would certainly follow from the further progress of science and from a more general and more thorough application of science to industry. The present membership of the advisory committee is as follows: Theodore N. Vail (chairman), Cleveland H. Dodge, George Eastman, E. H. Gary, A. W. Mellon, Pierre S. Du Pont, H. S. Pritchett, Edwin Wilbur Rice, Jr., Elihu Root, Ambrose Swasey.

The active work of the Section was undertaken in cooperation with the Engineering Foundation; and at a meeting held in New York on May 29, 1918, at which most of the members of the advisory committee were present, the following group was chosen to conduct this work: John Johnston (chairman); L. H. Baekeland, Naval Consulting Board; G. K. Burgess, Bureau of Standards; F. G. Cottrell, Bureau of Mines; A. D. Flinn, secretary of Engineering Foundation; C. E. K. Mees, Research Laboratory, Eastman Kodak Company; Walter Rautenstrauch, Columbia University; W. R. Whitney, Research Laboratory, General Electric Company.

It was considered that the first work to be undertaken should be propaganda, and it was planned to issue a series of bulletins written by men competent to deal with various aspects of the general subject. The demands of the war upon the time of these men, however, have delayed this plan, but it will be put into operation in the near future.

As an illustration of the fact that the industries in this country are awakening to the importance of industrial research, it may be mentioned that the National Association of Cotton Manufacturers at their annual meeting in May devoted an afternoon to consideration of "Research as an aid to industrial efficiency"; the addresses made at this meeting have been republished. (Transactions of the National Association of Cotton Manufacturers, 103–104, 545–592, 1918.) At the instance of the Industrial Relations Section of the Research Council a topical discussion on cooperation in industrial research was held at the meeting of the American Society for Testing Materials, which took place in Atlantic City on June 26, 1918. This session was largely attended, and those present evinced considerable interest in

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the matter. A full report of this discussion has been printed in the Proceedings of the Society (Vol. XVIII, Part II, pp. 1–63, 1918).

It was thought desirable to draft some concrete schemes for cooperative research, similar to those which have been formulated by the British Advisory Council for Scientific and Industrial Research, and an opportunity to do this was afforded by the newly organized American Zinc Institute, which requested the chairman of the Section to speak at its meeting in St. Louis on July 31, 1918, on the "Value of cooperative research work in the development of the zinc industry." The interest shown in this paper, which has been published in the Proceedings of the American Zinc Institute, 1918 (pp. 49–55), led the chairman to draft a provisional prospectus of a zinc research association. This prospectus was sent to the members of the Section, and with their approval was submitted to the American Zinc Institute, who are, we understand, giving this question very careful consideration.

One of the important industries upon which a large number of other industries depend is the refractories industry. This is more of a key industry than might at first sight appear to be the case. For instance, successful metallurgical practice depends upon satisfactory refractory furnace linings, and the need of chemical porcelain and glass is too well known to require further emphasis here. This industry has been in a relatively backward state in this country, and as most of the manufacturers engaged in it work upon a relatively small scale, it seemed to offer an exceptional opportunity for the establishment of a research association. Accordingly a scheme was drafted by Dr. E. W. Washburn, chairman of the Committee on Ceramic Chemistry, of the Council. This scheme is being presented to those interested in refractories and will be published in the near future. In this case, however, it is questionable if it will be feasible in the immediate future to get the manufacturers together; but it may be possible to arrange for research carried out by an organization supported by the users of refractories who, perhaps, are even more interested in the improvement of refractories than are the present manufacturers. Indeed, at a recent meeting of the Section it was considered that in many cases this might be the better way to proceed, and active steps toward the formation of an organization for alloy research on this basis are being taken.

Section on Relations with Educational Institutions and State Committees.—The sections on state council relations (through state research committees) and on research in educational institutions have been combined into one Section on Relations with Educational Institutions and State Committees, with Dr. J. C. Merriam as chairman, on account of the close relation of the problems with which the former two sections had to deal.

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The following states have formed committees on scientific research of their state councils, cooperating with the National Research Council: Arizona, California, Illinois, Indiana, Minnesota, New Hampshire, Oklahoma, Oregon, Tennessee, Utah, and Washington. University research committees have been formed in 88 institutions of learning. In some states these committees have been extremely active on emergency problems which have been carried forward through many special subcommittees. Throughout the war it has been the policy of the Research Council to encourage state scientific committees, scientific institutions, and scientific men to undertake at their own initiative such investigations as might bear on the successful prosecution of the war, and to invite their cooperation in the solution of emergency problems forwarded to them. In some cases special appropriations were made by the states to assist research committees and many institutions applied their research facilities to war work. Investigations thus undertaken frequently became so promising in their initial stages that they were taken over completely by federal or state authorities for continuation at government expense. The census of research men conducted in the states and institutions led to the recognition of investigators needed in government service, both civil and military. Many men have thus entered the national service through the activities of the state and university research committees in cooperation with the National Research Council. The service rendered the federal government in promoting the war has fully justified the establishment of state and university research committees. The results of this undertaking have been larger than could have been anticipated. At the same time a stimulus for scientific research has been created throughout the nation which will be of the highest importance in times of peace.

Reports of individual, state, and university research committees are being published by the state councils of defense and by the institutions.

At the request of the War Department's committee on education and special training the section has reviewed the qualifications of research men within draft limits for selection for governmental research work. The Research Council has accepted membership in the American Emergency Council on Education and has kept in close touch with this organization, which has done important work in bringing together the educational interests of the country, originally for war purposes, and since the armistice in connection with reconstruction problems. The Section has assembled a large amount of research information from the states and institutions, which has been distributed through the Research Information Service. It has also undertaken the compilation of research funds and fellowships available in the United States for research.

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The university research committees will naturally continue without much change in organization or policy after the close of the war. At the request of the committee, the Bureau of Education has undertaken to bring together organized information concerning the present status of research work, of the training of investigators, and of research staffs in educational and research institutions. One of the purposes is to determine whether the supply of men being trained for future work in various fields of research seems sufficiently large to meet the needs of the country. Another aim is to study the possibilities of fundamental university work after the war.

Special Committee on Education and Special Training (J. C. Merriam, chairman).—At the request of the Committee on Education and Special Training of the War Department, this Committee has undertaken, in cooperation with the Divisions of Science and Technology, the preparation of courses of instruction in the sciences contributing to the training of men preparing for military service and later more particularly of men enlisted in the Students' Army Training Corps at educational institutions. These courses of study have been forwarded by the War Department to the institutions in mimeographed form and have been of service in reorganizing curricula for the mobilization of their resources to meet the educational emergency needs of the Army and Navy. In some cases the science curricula have been expanded to syllabi and textbooks.

The committee has served as the connecting link between the Divisions of Science and Technology of the Council and the War Department's Committee on Education and Special Training in placing educational institutions on a war basis. It has cooperated with the War Department's committee, the Bureau of Education, and various other organizations in many other respects.

Committee on Reconstruction Problems (Vernon Kellogg, chairman; F. H. Newell, vice chairman).—The National Research Council, anticipating the end of the war, appointed a special committee on reconstruction problems, which completed its organization August 18, 1918, and adopted a program calling for a study of the agencies and activities that have to do with after-war problems.

The situation was discussed by conference, correspondence, and consultation of publications, and it was found that many organizations throughout the United States—federal, state, municipal, and private—have taken up or are about to take up one or another phase of these far-reaching matters. With the signing of the armistice in November, the reconstruction problems at home and abroad have come into the foreground, and plans were considered by the Council of National Defense and the state councils interested.

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After completing this general survey, the committee on reconstruction problems decided to limit its efforts to certain specific undertakings, which, as shown by the inquiry, have not been covered by other organizations. One of the most important and far-reaching of these is the research into details which relate to the control of water in its relation to food production and other industries.

At the present time there does not appear to be any one body or organization which is conducting a research into the mathematical, physical, and biological data bearing upon irrigation, drainage, flood control, and the application of these to engineering and agricultural science. It is recognized that many important undertakings are in the hands of several bureaus of the Government, each dealing with one phase or another of these subjects, and that a large amount of information has been collected and, by proper coordination, may be made available for research of the kind proposed.

The committee contemplates a report having to do with reconstruction, both at home and abroad, somewhat along the lines of a publication issued by the Division of Geology and Geography of the Council, entitled "Military Geology and Topography." The report, it is expected, will cover subjects of quantity, quality, and availability of water and its use in agriculture, power-production, and similar enterprises.

Under recent conditions the grouping, rounding out, and publication of data on water resources have peculiar value, since questions of water supply and control enter so largely into all reconstruction plans throughout the world.

In addition to the specific researches and preparation of the report referred to, the committee has also under consideration other lines of inquiry into reconstruction problems, which are in the course of development.

MILITARY DIVISION.

CHARLES D. WALCOTT, *Chairman;* S. W. STRATTON, *Vice Chairman.*

The Military Committee of the National Research Council, which was one of the first committees to be organized, was very effective in securing the necessary cooperation with the Army and Navy in the solution of research problems. Under the war organization this committee became the Military Division of the Council. The most valuable results of its work have been the organization of the Research Information Service and the authorization and organization of the weekly conferences on war problems of the Divisions of Physics and Engineering, in which representatives of the Army and Navy as well as the civil bureaus of the Government regularly participated (see report of Physics Division).

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DIVISION OF PHYSICS, MATHEMATICS, ASTRONOMY, AND GEOPHYSICS.

ROBERT A. MILLIKAN, *Chairman;* CHARLES E. MENDENHALL, *Vice Chairman.*

The membership of the executive committee of this division, fully set forth in the war organization appended to this report, includes representatives of physics, astronomy, mathematics, and geophysics. Effective cooperation between the various services of the Government was also provided for through the fact that these members were connected, respectively, with the Signal Corps, the Bureau of Aircraft Production, the Bureau of Ordnance of the Navy, the Bureau of Ordnance of the Army, the Chemical Warfare Service, the Weather Bureau, the Advisory Committee for Aeronautics, the Bureau of Standards, and the Carnegie Institution of Washington. The meetings of the executive committee were devoted to the discussion of war problems, and also to the preparation of plans for the permanent organization of the Division of Physical Sciences, the formulation of policies regarding the Research Information Service, the organization of research in the Army, and the establishment of the weekly conference of the Physics and Engineering Divisions. This conference was of such importance in connection with the war that a detailed statement regarding it should be included here.

In the spring of 1918 the Military Committee of the National Research Council, upon the initiative of the Division of Physics, authorized the establishment of a weekly conference of the Physics and Engineering Divisions for the discussion of the new scientific and technical problems facing both the Army and the Navy. These conferences were held each Thursday evening throughout the remainder of the year at the office of the Research Council, and were attended on the average by about 50 Army and Navy officers and civilian scientists engaged in war research. They proved of the greatest utility in furthering progress through the interchange of ideas between the different research groups both here and abroad. At each meeting all of the reports received through the Research Information Service from the foreign research groups since the last meeting were briefly summarized and discussed and detailed discussion devoted to such reports as warranted it. Further, these meetings became a recognized place of report of officers of our own service returning from Europe on scientific and technical missions and also of officers of foreign governments connected with the various foreign war missions. To preserve the necessary secrecy the meetings were held under the authority of the Army and Navy Intelligence Services, and the group authorized to attend consisted of the official representatives of the various war missions, officers specially delegated each week by the chiefs of the bureaus of the Army and Navy, and some

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30 civilian scientists, all of whom were passed upon by both the Army and Navy Intelligence Services. These meetings constituted one of the most effective war services rendered by the National Research Council, and had a marked effect in accelerating research and development projects and in pointing out useful new lines of endeavor.

As the major part of the reports sent to this country through the scientific attachés in London, Paris, and Rome have dealt with subjects coming directly within the field of the Physics Division, Dr. F. C. Blake was later appointed by the executive committee of the Division to study thoroughly all appropriate material coming in from abroad, and to arrange for its full presentation before the weekly conference of the Physics and Engineering Divisions and its distribution to the proper research groups in this country. He also assisted the Research Information Service in obtaining reports for transmission abroad upon physical problems under investigation in the United States.

It is clear from its membership and plan of organization that the Physics Division, like the Research Council itself, is a federation of research groups both inside and outside the War and Navy Departments and the civil branches of the Government. Many of the researches initiated under its auspices, as, for example, that on the submarine problem, were undertaken before most of its members were connected with the Army and Navy Departments. As the war progressed the membership of the Division became more and more completely incorporated into the Army and Navy, and large funds from both of these sources became available for the continuation of the work. Thus, the chairman and vice chairman of the Division were placed, in the autumn of 1917, in charge of the Science and Research Division of the Signal Corps, which was organized by the Research Council at the request of the Chief Signal Officer. The original problem organization of the Physics Division has been maintained, and the executive committee of the Division has continued to discuss and to make recommendations upon the various problems initiated by its members, whether these problems have in their later stages been financed by Research Council funds or by funds of those branches of the Army and Navy with which the members of the Division were subsequently connected.

The problems considered by the Division may be grouped under nine heads, as follows:

A. Airplane instruments.
B. Bomb sight, bomb trajectory, and stabilization problems.
C. Photographic problems.
D. Signaling problems.
E. Detection problems.
F. General airplane problems.

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G. Balloon problems.
H. Ordnance problems.
I. Miscellaneous problems.

Most of these were carried out under the Science and Research Division of the Signal Corps and the Bureau of Aircraft Production.

It would be impossible within the limits of this report to discuss the details of the seventy-odd problems in which the Physics Division was directly or indirectly concerned. Moreover, in many cases it would be manifestly inappropriate to do so, partly because of the confidential character of the work and more particularly because certain investigations were carried out at the expense and under the immediate direction of a branch of the Army or Navy or some body other than the National Research Council.

The nature of the council as a federation of research activities, and the fact that its prime concern is in the accomplishment of an important result rather than in the precise mode of procedure by which that result is obtained, naturally made its functions in the study of war problems very diverse. In some instances its work was limited to the initiation of investigations, which were sooner or later taken over by some other agency of the Government well qualified, through the possession of available funds and the necessary means of research, to conduct them to successful conclusion. In other cases, where suitable Government agencies were not available, the Research Council not only organized extensive investigations but provided funds and even erected laboratories provided with special equipment for solving vitally important problems. In the Physics Division these and other modes of procedure were all abundantly illustrated, as a detailed history of the origin, primary organization, and development of each problem dealt with would render clearly apparent. In this brief mention of the report of the Physics Division we must content ourselves with some reference to certain problems of special significance, in which the Research Council, for one reason or another, was called upon to play a leading part.

Perhaps the most notable case in point is the submarine problem. The importance of devising means for the detection and destruction of submarines was clearly apparent long before the United States entered the war. The Bureau of Steam Engineering of the Navy Department was fully alive to the importance of the problem, and in conjunction with the bureau the General Electric Co., the Western Electric Co., and the Submarine Signal Co. attacked the question with vigor. The Naval Consulting Board also recognized fully the seriousness of the situation and organized investigations of a similar character. As for the National Research Council it was recognized from the outset that this question, like many other scientific investi-

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gations dealt with under peace conditions, called for international cooperation. Accordingly the council dispatched a scientific committee, under the chairmanship of Prof. Joseph S. Ames, to France and England at the very beginning of the war to gather information bearing upon military and naval problems, and to secure early and effective cooperation in dealing with them. The French Government cordially responded, and a strong group of scientific men, under the chairmanship of M. Fabry, familiar with all aspects of the research problems dealt with in France from the beginning of the war, was sent to the United States upon a return visit. The English and Italian men of science, with whom arrangements for cooperation had also been made, sent representatives, including Sir Ernest Rutherford and Commander Cyprian Bridge from England and Lieut. Giorgio Abetti from Italy, to join the French committee in the United States.

Soon after the arrival of these gentlemen in Washington the Research Council, acting in cooperation with the Navy Department, organized a conference on the entire submarine problem, in which representatives of the Navy Department, with physicists and engineers already engaged in the study of the problem, joined with the French and British representatives. The results of this conference indicated such large possibilities that a group of some 50 physicists and engineers were brought together by the Research Council for a second three-day conference. As a result of these conferences a large number of investigations, for the most part dealing with the problem of submarine detection, were organized by the Research Council in cooperation with the Special Board on Anti-Submarine Devices of the Navy, which had entire jurisdiction over all anti-submarine experimenting in this country. The board consisted of a number of naval officers representing various bureaus of the Navy, together with four civilian members, one of whom was the chairman of the Physics Division of the Research Council and chairman of its Anti-Submarine Committee. The greater part of the experimental work of the Special Board on Anti-Submarine Devices was done at the New London Experimental Station, at which members of the Committee on Submarine Investigations of the National Research Council began work in June, 1917. The work of the Station attained such success in its initial stages that the Navy Department provided ample funds for its maintenance and development, and its work was subsequently carried out on a large scale at New London and elsewhere. Besides appointing the nucleus of the scientific group organized at New London and providing for initial expenses of travel, etc., the Research Council established additional antisubmarine groups at New York, Madison, Wis., Chicago, and in connection with the submarine base at San Pedro, Calif. A

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special laboratory was also erected at the expense of the Research Council at Pasadena, Calif., where marked success has been attained in the development of a special detection device by members of the San Pedro group.

This illustration has been given in some detail because it indicates clearly one of the chief modes of procedure of the Research Council. The many other investigations and activities set on foot by the division will doubtless be reported in due time from appropriate channels. Some of these, while involving research as an important factor, were primarily questions of the organization of scientific methods for military purposes. Thus, in the case of sound-ranging methods for the location of enemy artillery, the Research Council, at the request of the Chief Signal Officer, initiated the work by the appointment of Dr. Trowbridge at the head of the service, and the association with him of Dr. Rosa, Dr. Williams, and others. Dr. Trowbridge was appointed a major in the Signal Corps, and subsequently, after the work had been transferred to the Engineer Corps, he had charge of the service with the Army in France as a Lieutenant Colonel of Engineers. In this country, important developments in the methods were effected at the Bureau of Standards, at Princeton, and elsewhere, most of this work being done under the auspices of the Engineer Corps, and with funds furnished by them. The case of meteorology was somewhat similar, the Research Council taking part only in the initiation of the work, which was afterwards conducted on a large scale under the Signal Corps of the Army.

Among other problems in which the division was particularly interested were many dealing with special optical questions for secret signaling purposes, for increasing visibility at sea, for detecting camouflage, and for a variety of other purposes. The methods used in submarine detection furnished the basis for important devices for the detection and location of airplanes by sound, and for other problems involving the application of similar principles. Prof. Michelson, of the University of Chicago, was early in 1917 assigned by the Research Council to the problem of the development of an improved coincidence range-finder. This work has been carried on as part of the activity of the Physics Division of the Research Council, and with funds supplied by the University of Chicago up to the middle of 1918, when the preliminary instrument was approved by the Bureau of Ordnance of the Navy, Prof. Michelson given a commission in the Navy, and the problem from that time forth transferred to the Bureau of Standards, where it was financed by the Bureau of Ordnance of the Navy.

The study of bomb sights, bomb trajectories, and stabilization problems received much attention from the Physics and Engineering Divisions. Some of the developments of this work were very important, as they led to a marked reduction in the errors of bombing.

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At the request of the War and Navy Departments, the Research Council appointed a special group, of which Dr. Harvey N. Davis was chairman, to study and report upon the possibilities of obtaining helium from natural gas, through methods proposed by Mr. Norton, by the Linde Air Products Co. and by the Air Reduction Co. Dr. Davis, who contributed in an important degree to the success attained by the Army, the Navy, and the Bureau of Mines in this work, was later made the representative of the Army in dealing with the problem. At the time of the signing of the armistice 147,000 cubic feet of helium were ready for shipment abroad.

Among other balloon problems studied by Research Council groups were those dealing with the elimination of explosions due to sparks (Drs. Swann and Fulcher) and the method of ignition of hydrogen balloons by incendiary bullets (Drs. Davis, Fulcher, Wells, and others).

Another activity of the Physics Division, working in cooperation with the Engineering Division of the Research Council, and with members of the Bureau of Aircraft Production, was the development of a special device of sounding balloons, referred to in the report of the Engineering Division. In cooperation with the Signal Corps and the Weather Bureau, an important application of these balloons to the study of upper-air currents was also recognized.

A Research Council group, consisting of Dr. Paul Klopsteg, of the University of Minnesota, and Dr. Rosa, of the Bureau of Standards, was formed in the summer of 1917 for developing new and improved methods of measuring initial speed of projectiles. This group successfully developed a new method which has been adopted to some extent, both in this country and abroad. It diminishes greatly the time required to make speed determinations. This work was financed principally by the Bureau of Ordnance of the Army.

At the initiative of the Physics Division and with funds furnished chiefly by the Signal Corps and partly by the Research Council, Dr. D. C. Miller, of Cleveland, spent a large part of the summer of the year 1918 in the development of special apparatus to be used in a complete study of the pressure wave about the muzzle of a large gun.

Prof. Raymond Dodge, of the Psychology Committee, was brought into contact, through the activities of the chairman and vice chairman of the Physics Division, with the need for a piece of physical apparatus for the selection and training of gun pointers. Prof. Dodge developed for the Navy a most satisfactory physical instrument, which has been adopted and used both here and abroad.

At the request of the General Staff, the Physics Division of the Research Council appointed a special committee, with Edward P. Hyde, of Cleveland, as chairman, for making a scientific study and report upon the relative merits of monoculars and binoculars. This

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committee made very elaborate investigations, both in the laboratory and with a group of 70 officers of the General Staff in the field.

A special committee of the Research Council, consisting of Dr. C. G. Abbot, chairman, and certain members of the Bureau of Standards and of the Engineer Corps of the Army, was appointed in the fall of 1917 for improving the searchlight. This committee has done a large amount of work which has resulted in useful developments, which have not, however, as yet come into practice.

The Research Council has had a committee, consisting of Drs. H. N. Russell and G. B. Pegram, which has cooperated with Maj. Boyle, of the Department of Ordnance, in the development of anti-aircraft fire-control devices.

These illustrations will suffice to indicate the character of the work of the Physics Division. Reference must be made to subsequent special reports for the details of the work.

ENGINEERING DIVISION.

HENRY M. HOWE, *Chairman;* G. H. CLEVENGER, *Vice Chairman.*

The Engineering Division was organized in March, 1918, and Dr. Henry M. Howe was appointed chairman in April, 1918. The Division as originally constituted consisted of—

1. Section on Metallurgy, under the chairmanship of Prof. Bradley Stoughton.
2. Section on Mechanical Engineering, under the chairmanship of Mr. W. J. Lester.
3. Section on Electrical Engineering, under the chairmanship of Prof. C. A. Adams.
4. Section on Prime Movers, under the chairmanship of Prof. Lionel S. Marks.

In order to be of the greatest assistance in winning the war, each section took up the problems of most immediate need, and attacked them in the manner which appeared to give promise of the most efficient and rapid solution. This accounts in a large measure for the radically different methods pursued in the different sections, and also accounts for what may appear to be a lack of balance between the sections.

SECTION ON METALLURGY.

The section on metallurgy has worked chiefly through the creation of committees which during the war period attacked specific problems of importance in connection with the war.

Pyrometer committee.—The committee was formed under the chairmanship of Dr. G. K. Burgess for the purpose of developing a pyrometer for measuring the temperature of steel baths in furnaces, especially in open-hearth and electric furnaces. A satisfactory instrument for this purpose would result in better control of the process

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of manufacture, and hence an improvement in the quality of the steel produced. Under the direction of Mr. F. E. Bash a considerable amount of experimental work was carried out at the plant of the Midvale Steel Co. The results of this work indicate probable lines along which successes can be attained.

Ingot committee.—This committee was formed for the purpose of determining the best practice in the making of steel ingots. It was under the chairmanship of Lieut. Col. W. P. Barba. At the time of the signing of the armistice the Ingot Committee was arranging to publish under the form of "Recommended practice" a complete set of detailed directions covering the practice of the best makers of fine steel suitable for guns, shells, etc., practice which until then had been kept strictly secret. This was to be done through the collaboration of the metallurgists of the Ordnance Department, ordnance engineers, and eminent metallurgists of the most important makers of ordnance steel in this country. The preparation of this "recommended practice" is still being carried on by Dr. Howe.

Fatigue phenomena committee.—A committee for the study of this important subject was formed, and Prof. F. H. Moore made chairman. As a result of the work of this committee advances were made in the existing knowledge of fatigue of metals, and the permanence of the elevation of the elastic limit caused by distortion in the cold. The results of this investigation, so far as it has proceeded, are recorded in a paper to be presented at the February meeting of the American Institute of Mining Engineers. Briefly, it tends to show that the elevation of the elastic limit caused by cold rolling, wire drawing, etc., is dissipated by indefinite repetition of a wide variation of stresses, as for instance in aircraft crank shafts.

Protective body armor committee.—Maj. Bashford Dean was chairman of this committee, one group of which was active for a considerable period in the study of old types of body armor and their adaptation to modern warfare. The other group of this committee, under Dr. Howe, devoted to the study of the best types of steel for helmets, has been particularly active. Some of the steels experimented with have shown greatly superior resistance to denting and perforation as compared with the regulation manganese steel helmets formerly used. This research is being continued by Mr. W. J. Wrighton, and when completed will offer a great deal of information upon the subject not previously known.

Manganese saving committee.—This committee, under the chairmanship of Mr. J. E. Johnson, jr., in cooperation with the United States Bureau of Mines, studied the practice of producing ferromanganese and its use in steel making. The results of this work pointed to the possibility of improvements in the practice of steel making which would effect a saving of manganese resources, thereby

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releasing the shipping which at the time was engaged in the importation of manganese ores. The results of these studies are embodied in two papers which will be presented at the February meeting of the American Institute of Mining Engineers.

Metallurgy subcommittee of welding committee.—This committee was formed for studying the metallurgical problems arising in connection with the work of the electric welding committee. It is a subcommittee of the welding research subcommittee, and its chairman is Mr. S. W. Miller. This committee has made important progress in ascertaining the causes of the brittleness of autogenous welds, more particularly electric welds. The more important conclusions which have been reached as a result of their work will be discussed in a paper which will be presented at the February meeting of the American Institute of Mining Engineers.

New committees.—In addition to the above committees a number of new committees were being formed at the time the armistice was signed. There are now a total of 16 committees in the Section of Metallurgy. The work of the older committees, as well as the newly-formed committees, is steadily going forward, as it is generally recognized that all the subjects covered by the work of these committees are of great importance in peace time.

SECTION ON MECHANICAL ENGINEERING.

The Section on Mechanical Engineering had presented to it an entirely different type of problems from those arising in connection with metallurgy. The work in this Section has consisted largely in the development of certain war inventions, most of which came to it in a nebulous state. In order to do this work effectively, it was necessary to have a staff of designing engineers and draftsmen, also a shop with a full complement of machinists, experimenters, etc., for constructing full size or working models of the various devices. Through the courtesy of the Carnegie Institute of Technology, a large section of their shops was rendered available for this work. Under the direction of Lieut. T. H. Sloan a considerable force of both enlisted men and civilians has carried on this work since July, certain of the devices being of such promise that work has been continued on them since the armistice was signed.

Telescope signaling.—The Section of Mechanical Engineering cooperated with the Physics Division and with Maj. Wood, of the Signal Corps, in the redesign of the original telescope signaling device. After this instrument was approved 100 of them were manufactured in the Pittsburgh shops and were ready for shipment abroad when the armistice was signed.

Dual control cut-out.—As the result of a conference of the Physics Division with Mr. W. J. Lester, chairman of the Section of Mechanical Engineering, he was requested to develop certain ideas which he had

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for a dual control for airplanes, in which the instructor could at any time mechanically disconnect the beginner's control. It was believed that a device which would render this possible would considerably reduce the number of accidents at airplane training fields. The device developed gave satisfactory results in a preliminary test.

Long-range propaganda balloons.—Through the energy and perseverance of Mr. W. J. Lester, with the later cooperation of the Science and Research Division of the Signal Corps, means of automatically maintaining small balloons at any predetermined altitude by alternately throwing out liquid ballast and releasing gas were worked out and thoroughly tested. Results of this work were highly satisfactory. Tests made by setting the control mechanism for an altitude at which it was known the prevailing easterly air currents would be encountered, using balloons but 9 inches in diameter (before inflation), resulted in several balloons traveling easterly from Fort Omaha for a distance of nearly 1,000 miles, and one traveled a distance of over 1,100 miles. This is a much greater distance than that ever previously covered by the flight of small balloons. They were at once sent by special messenger for use at the French front. It is now proposed to use these balloons for ascertaining the air currents above the Atlantic Ocean between the American and European coasts.

Armored motorcycle.—It was evident that casualities among our troops during open fighting could be greatly reduced if there was a means of carrying forward with them small armor-plate shields in sufficient numbers. It was essential that such a device should be capable of production in very large numbers and in a minimum length of time. To meet this need a design embodying a standard motorcycle was developed and one of the machines assembled at the plant of the Savage Arms Co.

Centrifugal gun.—The designing and construction of a centrifugal gun, which grew out of plans originally submitted by Mr. E. L. Rice, has been carried forward by this section, in cooperation with the Physics Division, at the Pittsburgh shops. Most of the previous designs for such a gun have had a common defect which has been difficult to eliminate. Considerable headway has been made in solving this problem, and it is thought possible that this type of gun may be eventually developed into an effective weapon.

Improved carburetor.—A new type of carburetor for use on airplanes was designed and constructed, but has not yet been tested.

Other work in which more or less progress was made was a rotary internal-combustion engine, parachute for airplanes, pneumatic antisubmarine gun, supertank, locking differential for motor trucks, walking-beam tractor for use in extremely soft ground, automatic

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constant speed airplane propeller, balloon flare, compressed-air drive for centrifugal gun, hovering airplane designed to remain stationary in the air, and a double-propeller engine.

SECTION ON ELECTRICAL ENGINEERING.

The work of this Section was confined to the intensive study of electric welding, more particularly, as applied to shipbuilding. A large and very active committee, under the chairmanship of Prof. C. A. Adams, worked upon this problem in cooperation with the Emergency Fleet Corporation of the United States Shipping Board. Working with the welding committee was a subresearch committee under the chairmanship of Mr. H. M. Hobart, and working with the subresearch committee was a submetallurgical committee under the chairmanship of Mr. S. W. Miller.

As a result of the well-organized work of this large group, noteworthy advances were made in the practice and use of electric welding as applied to shipbuilding. A steel barge was fabricated, employing electric welding throughout, no rivets whatever being used. This barge was successfully completed and placed in commission. This achievement may be considered an important step in the evolution of a completely electrically welded ship. Several new and important laws were established in connection with the art of welding and the relation between the qualities of welds and the structure and constitution of the steel. These researches are embodied in a series of papers to be presented at the joint meeting of the American Institute of Electrical Engineers and the American Institute of Mining Engineers to be held in February.

In order to continue the research work on welding, which was begun and carried forward under the auspices of the Emergency Fleet Corporation until January 1, plans have been formulated for the formation of a Welding Association through which adequate financial support will be provided for the investigation of this subject.

SECTION ON PRIME MOVERS.

The activities of this Section have been confined largely to general work upon the problems connected with power plants for aircraft. The general subjects covered have been (1) the development of motors with lower weight per horsepower than those now in use, (2) the development of carburetors to maintain high engine efficiency and capacity at all altitudes, (3) the development of means for increasing the power of airplane engines at high altitudes, (4) the development of fuels to increase the efficiency and capacity of the airplane motors. The most important project undertaken by this Section has been the design of a special airplane engine of great promise.

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DIVISION OF CHEMISTRY AND CHEMICAL TECHNOLOGY.

JOHN JOHNSTON, chairman; E. W. WASHBURN, vice chairman.

The chief effort of the Division of Chemistry and Chemical Technology during the year 1918 has been to secure effective cooperation in the investigation and solution of the many pressing problems involving chemistry and chemical technology raised by the war. Much of the time of its officers and committees has been given to service as a clearing house of information and advice in connection with a great variety of problems. In this connection it has been in close touch with nearly all branches of the Government as well as with foreign military and industrial missions and research organizations, and with many private interests, both in this country and abroad. The problems handled in this way have been so numerous and varied in character that even an enumeration of them is impracticable in this place. The committees of the Division and its special consultants have been especially valuable in connection with this work, and it is largely through them that the Division has been able to give the information and advice which has been requested of it.

Owing to the existence of numerous chemical laboratories, either under the immediate control of the Government or connected with the universities and industries of the country, whose resources and staffs were available for research, the Division early reached the conclusion that it was neither necessary nor desirable for it to undertake to carry out investigations itself. Where problems requiring research have been presented to the Division it has therefore been its policy to have these problems taken up by some one of the laboratories already in existence, preferably a Government laboratory, wherever the necessary facilities were available. In order to supplement the work of the Government laboratories and to mobilize as effectively as possible all of the research resources of the country for work upon war problems, the Division has during the last year secured from various governmental agencies concerned with matters involving chemical questions, problems which could not be adequately dealt with under the conditions existing in the governmental laboratories during war time. These problems, of which about 50 had been received when the war ended, were then formulated and assigned for investigation to men in private laboratories or in educational institutions. They cover a very wide range, from investigations of the physical properties of toxic liquids and explosive substances and of methods for combating toxic gases, to studies designed to relieve shortages of necessary materials or to utilize by-products and wastes.

At the request of the War Department's Committee on Education and Special Training the Division prepared a series of recommenda-

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tions for the training of chemists in the Student Army Training Corps, including detailed statements concerning the content of courses, together with special two and three-year war curricula in chemistry and chemical engineering. These recommendations and curricula received the approval of the General Staff, and were in general use at educational institutions having units of the Student Army Training Corps.

ACTIVITIES OF THE COMMITTEES OF THE DIVISION.

Some of the main activities of the committees of the Division may be stated as follows:

1. *Committee on the chemistry of soils and fertilizers.*—This committee prepared a census of the potash needs of the United States for agricultural purposes in 1918, a summary of which was published in the Quarterly Journal of Economics for February, 1918, under the title "The fertilizer needs of the United States." The committee has also urged upon the geological surveys of various States the importance of systematic surveys for the location of potash deposits, especially in connection with deep drilling operations.

A number of Agricultural Experiment Stations have cooperated with the committee in experiments on the availability of phosphoric acid for plant food and of potash in ceresites; likewise in testing the effect of the treatment of seeds before planting, with certain soluble fertilizing ingredients, and in a study of different methods of soil treatment and fertilizing in connection with potato culture.

2. *Committee on the chemistry of rubber and allied substances.*—This committee has investigated the subject of rubber content of certain California shrubs and has been continuously in cooperation with the Quartermaster's Department in the preparation of specifications and standard tests for rubber compounds, with special reference to automobile tires and tubes. It has also carried out investigations on the recovery of cotton from scrap tire fabric and tire waste, and has cooperated in certain rubber work required in connection with the preparation of submarine detectors.

3. *Committee on the chemistry of fuels and combustion.*—This committee has concentrated its efforts in obtaining a better fuel for airplane motors through cooperation with the United States Bureau of Mines and the United States Bureau of Standards, the various aviation fields, and the British War Mission, and the fuels which have shown most promise have been submitted to actual flying tests, both in the United States and abroad.

The Engineering Experiment Station of Purdue University has also cooperated with the committee in an extensive series of tests on

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carburetors for the purpose of determining various losses of efficiency, to ascertain the causes thereof, and to suggest remedies.

4. *Committee on apparatus and supplies.*—This committee has been active in assisting in the location of special types of apparatus and measuring instruments required by different governmental agencies, and in securing the manufacture of certain types of apparatus not otherwise available on the American market.

Some of the subjects to which attention has been given are apparatus statistics, duty free importations for educational institutions, manufacture of certain types of apparatus and measuring instruments for student use, standardization of certain types of apparatus, and preparation of satisfactory descriptions of types of measuring instruments, together with instructions for use.

5. *Committee on the chemistry of ceramics.*—This committee has issued a report outlining projects for a cooperative geological and ceramic survey of ceramic raw materials with a result that a conference including representatives of various Government bureaus, the American Ceramic Society, and the Association of American State Geologists has been held and that a systematic study of the ceramic resources of a number of States is now in progress. The proceedings of this convention have been published.

At the request of the United States Fuel Administration the committee has had prepared a synopsis of a course in chemistry combustion and fuel engineering, and at the request of the War Department a special war curriculum in ceramic engineering was prepared for use by the Students' Army Training Corps.

6. *Committee on synthetic drugs.*—This committee has advised the Federal Trade Commission with regard to licenses under the trading with the enemy act for the manufacture of synthetic drugs by patented processes belonging to the enemy, with a result that the Commission not only requires a recommendation from the committee, but also requires that an applicant for a license submit to the committee a specimen of the drug for which the license is desired to undertake such production.

The committee has also cooperated with the Federal Trade Commission and with the United States Public Health Service in the production of adequate quantities of licensed drugs, in interesting manufacturers of drugs to undertake such production, and in standardizing methods of manufacture and of testing certain drugs. The following specific results may be instanced: Arsphenamine, procaine, and barbital are now being produced in quantity in this country, and a license has been taken out for the manufacture of atophan. Holocaine, euphthalmine, and a long list of unprotected articles are either entirely available or about ready to be marketed, and preparations

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for large-scale production of luminal, a specific for epileptics, are well forward.

7. *Committee on the chemistry of dyestuffs and textiles.*—This committee has cooperated with the War Industries Board and the United States Bureau of Standards in the preparation of standard specifications for the waterproofing of fabrics; a report is in process of preparation. Cooperation with governmental agencies has also been secured in a study of problems connected with dyestuffs and dyed fabrics.

8. *Committee on the chemistry of colloids.*—This committee has cooperated with governmental agencies in the preparation of standard specifications for glues and gelatin.

9. *Committee on chemical engineering.*—This committee has aided effectively in preparing an organization for bringing the services of American chemical engineers more directly and more fully to the aid of the Government.

COMMITTEE ON EXPLOSIVES INVESTIGATIONS.

This joint committee was created July 1, 1918, with the approval of the Secretary of War and the Secretary of the Navy—

(1) To survey the investigations on explosives now under way and to keep closely in touch with their subsequent progress.

(2) To gather and communicate to the proper military and naval authorities all information available in regard to such investigations.

(3) To bring to the attention of the proper military and naval authorities proposals for supplementary investigations relating to explosives, and to arrange for the prosecution of such investigations by the civil bureaus of the Government, by industrial companies, and by universities and endowed research institutions.

The committee was composed of Col. W. C. Spruance, Ordnance, United States Army, nominated by the Chief of Ordnance of the Army; Lieut. Commander T. S. Wilkinson, United States Navy, nominated by the Chief of Ordnance of the Navy; Mr. L. L. Summers, representing the War Industries Board; with Dr. Charles E. Munroe, designated by the National Research Council as chairman.

On the recommendation of the committee, Mr. G. A. Rankin, of the Bureau of Mines, was appointed technical assistant by the National Research Council, while Maj. J. H. Hunter, Ordnance, United States Army, Lieut. (Junior Grade) H. H. Armstrong, United States Navy, and Mr. M. F. Chase, of the War Industries Board, were designated liason attachés for their respective services.

It was decided that to perform the assigned duties a record should be made of the investigations on explosives which were completed or

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in progress; with this object a canvass was made of all the divisions of the Government, of the industrial companies of the United States engaged in the manufacture of explosives, of the universities, and of the private research institutions. It was decided at the outset that the committee should seek only the titles of these investigations, with sufficient data relative to the filing of the reports on them to identify them when sought, and that this information should be carded in such form as to be readily accessible. It is gratifying to report that in every instance the investigators, though connected with manufacturing establishments, have promptly furnished full reports of their investigations. By order the records of the War and Navy Departments relating to explosives investigations were also made available.

The returns from the canvasses made have been most gratifying. This information has been supplemented by the reports from the scientific attachés in London, Paris, and Rome of the investigations made and in progress in Great Britain, France, and Italy sent directly to the National Research Council, and by reports from these sources supplied to the War and Navy Departments. This information is being carded, there having been over 2,500 cards thus far prepared.

As information has been received it has been communicated to the officials of the War and Navy Departments, sometimes by correspondence, but usually through liaison attachés, and it has repeatedly occurred that certain of these reports have been requested as bearing upon the work in hand. Advice and counsel on matters relating to explosives has frequently been sought by many divisions of the Government. Incidentally the committee, through the scientific attachés of the National Research Council, has furnished information requested by the allied Governments.

The committee at its meetings has thoroughly considered the duties set forth in (3) and after a review of the record has assigned subjects for investigation. Some of these investigations have already been reported upon and the results have been considered valuable by the authorities.

COMMITTEE ON NITRATE INVESTIGATIONS.

In May, 1918, the Secretary of War requested the National Research Council to designate two or more research men, to be appointed consulting chemists to the Ordnance Department, and who, together with the officer in charge of the research section of the Nitrate Division, shall constitute a small executive committee whose duties shall be (*a*) to survey the researches now in progress, (*b*) to plan further investigations relating to nitrogen-fixation processes, (*c*) to arrange for the active prosecution of such investigations, and (*d*)

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to exercise close oversight over their progress; the actions taken by this committee and the allotment of funds recommended by it to be subject to the approval of the chief of the Nitrate Division.

This committee was immediately constituted by the National Research Council, with Arthur A. Noyes, chairman of the Nitrate Commission of the War Department, as chairman, and with John Johnston, chairman of the Division of Chemistry and Chemical Technology of the National Research Council, and Lieut. Col. Alfred H. White, in charge of the research section of the Nitrate Division of the Ordnance Department, as the other two members.

During the past year this committee has kept in close touch with all the research and development work in progress under the Nitrate Division. It has specifically been largely instrumental in arranging for the following activities:

1. Through an understanding with the Chief of the Bureau of Chemistry of the Department of Agriculture and the Secretary of that department, the unfinished laboratory of that bureau located at the Arlington Farm was temporarily placed at the disposal of the Nitrate Division, was equipped with the necessary machinery, and was utilized for the study of the production on a semi-industrial scale of the catalyst used in the synthetic ammonia process at United States Nitrate Plant No. 1 at Sheffield, Alabama.

2. By a similar arrangement with the Department of Agriculture the laboratory of the Bureau of Soils at the Arlington Farm and its personnel were temporarily transferred to the Nitrate Division; and the plant already installed there for the testing of catalysts for the synthetic ammonia process was greatly enlarged and improved.

3. An arrangement was made with the director of the Geophysical Laboratory of the Carnegie Institution of Washington, and with the president of that Institution, by which investigations on the cyanide process of nitrogen fixation and on catalysts for the ammonia synthesis were undertaken by the staff of the laboratory, assisted by men appointed by the Nitrate Division. The services of Dr. E. C. Franklin, one of the leading authorities on nitrogen compounds, were secured for this work.

4. An experimental investigation on the principles underlying the absorption of nitrous vapors in water was started at the Massachusetts Institute of Technology, and the process there worked out was afterwards tried out on a semi-industrial scale with successful results at the United States nitrate plant at Sheffield, Alabama.

5. There was actively enlisted in the nitrate research work the interest of Dr. W. R. Whitney, director of the Research Laboratory of the General Electric Co., who gave valuable advice in regard to the nitrogen problems in general and inaugurated experimental work in his own laboratory on catalysts for the ammonia synthesis.

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6. The chairman of the nitrate investigations committee, in company with Mr. C. P. Townsend, was sent to England and France for a period of two months to study the recent developments of nitrogen processes and the researches in progress there.

7. A detailed plan for the organization on a permanent basis of a bureau of research and development to take charge of nitrate investigations was presented to the Assistant Secretary of War.

DIVISION OF GEOLOGY AND GEOGRAPHY.

WHITMAN CROSS, *Chairman.*

The Division was organized early in January under the chairmanship of Dr. J. C. Merriam and succeeded to the work of the committee on geology and paleontology and the committee on geography. These committees were not discharged, but have been retained as advisory bodies on problems of general character. Much of the work of these committees was finished in 1917, but certain projects were further developed by the Division and will appear in the following statement.

The Division has held 29 meetings during the year. It has often called upon geologists and geographers of the country for conferences on special subjects.

GENERAL ACTIVITIES OF THE DIVISION.

1. A report on materials and facilities for rapid road and fortification construction in the coastal States from Maine to Texas was prepared by the Geology Committee, under the immediate direction of W. B. Clark, and completed on his death by Edward B. Mathews. This report has been placed at the disposal of the Chief of Engineers, and a copy has also been deposited with the United States Geological Survey, where it has been consulted by many Government agencies. It has been of especial use in connection with concrete construction work.

2. *Information as to the geology and geography of the environments of Army cantonments and camps in the United States.* At the suggestion of the Geology Committee, Federal State surveys undertook the preparation of bulletins, and several have been published during the year 1918.

3. *Information as to the geography of the western front in Europe.* Portions of the work, Topography and Strategy in the War, by Douglas W. Johnson, dealing with the western front, have been republished in separate form and gratuitously distributed among the officers of the United States Army at the cantonments and camps as

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well as in Europe. This distribution was initiated by the Geology Committee and made possible by the generosity of one of its members. The American Library Association ordered several hundred copies of this separate for use in libraries at camps.

Several thousand copies of the Handbook of Northern France, by Prof. William M. Davis, chairman of the Geography Committee, have been gratuitously distributed among officers of the Army. This was possible through generous contributions secured by the author. The publication was issued at cost by the Harvard University Press and distributed without profit to the author.

4. *The utilization of geologists as experts in the American Army.* A memorandum on the usefulness of geological advice in the operations of an army was presented to the Secretary of War by the Geology Committee in 1917. During the past year the geological war service in the German Army, as described in German literature, has been brought to the attention of the Army authorities, and a considerable development of such service has taken place in our Army. The Division has improved every opportunity to make clear the value of this special service.

5. Maj. Johnson, a member of the division, was able to make important observations concerning geological and geographical work in several of the allied armies and in the German Army, and has submitted important reports upon this subject, which have been transmitted to the War Department.

6. *Instruction in geology, geography, map reading, etc., in training camps and colleges.* An effort to promote work of this kind was initiated by the geology committee in 1917. With the organization of the Students' Army Training Corps the opportunity for developing the desired instruction was offered. At the request of the military Committee on Education and Special Training the Division of Geology and Geography prepared courses in geology, geography, map reading, and meteorology. The evident need for textbooks in these courses was supplied by a special committee of the Division, of which Prof. Herbert E. Gregory was chairman, and the following textbooks were prepared: Military Geology and Topography, Introductory Meteorology, and a syllabus on the geography of Europe. Prof. Gregory acted as the editor of this series of textbooks. Introductory Meteorology was prepared mainly through the hearty cooperation of members of the staff of the United States Weather Bureau.

COOPERATION WITH GOVERNMENT BUREAUS AND OTHER ORGANIZATIONS.

7. *Research Information Service.* The Division has supplied to our allies, through the Research Information Service, a considerable

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amount of information on geological and geographical subjects. This has been carried on through both the London and the Paris offices of the Research Information Service. Information has also been secured from the English, French, and Italian Governments through the Service.

8. *Military Intelligence Division, Office of the Chief of Staff.* The Division has cooperated throughout the year with the Military Intelligence Division to furnish information on geological and geographical subjects.

9. The chairman of the Division has been a member of the Joint Information Board on Minerals and Derivatives and has taken part in the work of that board.

10. The Division has cooperated with the United States Geological Survey, the United States Bureau of Mines, the Fuel Administration, and other boards to secure special reports on subjects pertaining to the mineral and fuel supply of the United States and of foreign countries available for war purposes.

11. The California State Council of Defense has transmitted to this Division a number of reports prepared by its committee on geology and mineral resources, concerning the supply of important war minerals in California. These reports have been utilized by the Division in supplying information to various Government bureaus.

12. *Clear-quartz resources of the United States.* An investigation was made by Dr. G. P. Merrill, as a committee of the Division, as to the clear-quartz resources of the United States with reference to the use of this material in certain instruments. An investigation of quartz appearances in California, by Prof. A. F. Rogers, was made in connection with this report. The expense of both investigations was borne by the Research Council from funds allotted to this Division.

DIVISION OF MEDICINE AND RELATED SCIENCES.

Col. F. F. Russell, M. C., U. S. Army, *Acting Chairman;* Maj. R. G. Hussey, M. C., U. S. Army, *Vice Chairman.*

The present organization of the Medical Division has been in existence since February, 1918, when it was established under the chairmanship of Dr. Richard M. Pearce, who was later assisted by Dr. Peyton Rous, as vice chairman. Previous to this date the medical sciences were represented by several different committees, in accordance with the general plan of the Council's organization at that time. Those existing committees of the original Council, representing sciences concerned with problems dealing with the cause, prevention, and treatment of disease states among the military and war-industry forces, as well as those representing sciences concerned with the mental and physical fitness of individuals for military service,

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were grouped to form a nucleus for the Division of Medicine and Related Sciences. These committees retained their titles and personnel, and the researches then in progress under their direction were continued by them without interference.

In the subsequent development of the Division (see War Organization, p. 107) there has been a constant effort to recognize those applied sciences upon which medical problems are so fundamentally dependent that they are an actual necessity for thoroughness in medical investigation, and to include these in its organization. Investigators in these sciences were and have continued to be enrolled to serve on committees or subcommittees.

In the main the purpose of the Division from the beginning has been to mobilize the civilian medical and related scientific workers and institutions, with their laboratories, in the United States, thus organizing a united scientific medical service for aiding in the solution of problems bearing upon and promoting the efficiency of national defense. This has been accomplished by close cooperative contact with the Surgeon General of the Army, through Col. Russell, with the Surgeon General of the Navy, through Dr. Stitt, and with the most hearty support and cooperation from the many scientific investigators throughout the country.

The general plan has been to follow the advice of representatives of the War, Navy, and Labor Departments in determining urgent problems, and then to find the proper workers to investigate them. The committee plan has been adhered to as far as it has been possible; but there have been many instances where individuals working independently of committees have given their entire time and laboratory facilities to the work on war problems. The committees and subcommittees dealing with such problems, at the time of the signing of the armistice, were constituted as shown on page 107.

Lack of space prohibits any detailed statement of the many problems taken up by the different committees or by individuals working in connection with the Division. However, a word about some of these seems necessary.

1. Much has been accomplished as a result of investigations undertaken to study traumatic shock; although the results have by no means entirely explained the phenomenon, they have given illumination to certain clinical aspects of the problems.

2. Investigations concerned with the control of lice and their eggs, and preventive measures against infestation, have resulted in the development of effective insecticides and methods of delousing.

3. A method has been found for the prevention of post-operative neuromata in amputation stumps.

4. Much attention has been devoted to the cultivation and collection for pharmacological study of native medicinal plants. As a re-

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sult, all of the digitalis now required for use in the Army is grown and tested by scientists at the University of Minnesota.

5. Acetone, a necessary solvent for airplane varnishes, was almost unobtainable in the early months of the war. A simple method has now been worked out for its production and put into practical operation by the Government.

6. The work of the Committee on Industrial Poisonings has brought to light facts of great importance, which have resulted in steps being taken to protect the health of munitions plant workers.

7. Investigations concerning the cause and prevention of the existing epidemic disease ("influenza") have been encouraged and supported to the fullest extent. It is at this time too early to make any statements regarding results, but it is hoped that in the near future some important facts will be forthcoming.

The following list gives by title only the complete roster of researches commenced. Many of these have been completed and papers on the results have either been published in journals or are official documents in the files of the Council.

A. *Under direction of the Executive Committee of the Division:*

1. The development of protectors for the ear against effects of high explosives.[1]

2. New methods for the production of acetone.[1]

3. General testing of new antiseptics and special study of application of the same (2 stations).[1]

4. Studies of anaerobic bacteria of importance in war wounds (3 stations).[1]

5. The cultivation, collection and pharmacological study of native medicinal plants (3 stations).[1]

6. Determination of substitutes for ambrine.[1]

7. A study of gases as disinfectants of wounds and their use to render disease carriers innocuous.[1]

8. Sterlization of drinking water for large bodies of troops.[1]

9. A critical study of methods of small-pox vaccination on a large scale.[1]

10. The value of the agglutination test after vaccination against typhoid fever.[1]

11. A study of rare and unusual sugars in the different strains of pneumococcus, streptococcus, and meningococcus.

12. A study of hemostatic preparation.[1]

13. Studies of peripheral nerve injury and repair, with special reference to the prevention of amputation neuromata.

14. Studies of streptococcus infection, with special reference to empyema.

15. A study of possible substitutes for the petri dish.

16. War (?) edema among infants.

17. Chemotherapeutic studies of experimental pneumococcus infection.

18. Tests to devise a gauze mask effective in the prevention of droplet infection.

19. A study of the cause of the so-called Spanish influenza and its possible prevention by vaccination.

[1] Research in progress under the direction of the Committee on Medicine and Hygiene as constituted in the original organization of the Council (Col. Victor Vaughan, chairman).

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20. Tests of the influence of slow intravenous injections of foreign serum in the prevention of anaphylactic shock with special reference to the army use of antitoxic sera.

21. Chloralose as a general anesthetic in cases of shock.

22. Skin grafting as conditioned by the blood group of donor and recipient.

23. The use of "immunized" skin grafts in infected wounds.

24. Gentian violet as an antiseptic for "preserved blood" used in transfusions.

25. Methods to increase the yield of serum-antibodies in immunized animals.

26. A simplified and improved apparatus for transfusions.

27. A study of the importance of antiagglutinins for transfusion.

28. A test to disclose oxygen-lack in the air of submarines and mines.

B. *Committee on industrial poisonings:*

1. An experimental study of toxic effects of substances entering into the manufacture and handling of explosives. (1 station, 7 workers.)

2. A study of early signs of intoxications among munitions workers. (8 field workers in 6 munitions plants.)

3. A study of airplane "dopes."

4. The devolpment of protective varnishes or other skin coverings.

C. *Committee on toxicity of preserved foods:*

1. Studies of canning and other methods of preserving food.[1]

2. The related problems of botulism.

D. *Committee on neurology and psychiatry:*

1. An analysis of 13,000 records of soldiers discharged from service on account of nervous and mental disturbances.

2. The early histological lesions of meningoencephalitis. (From material of the Army Medical Museum.)

E. *Committee on the study of the physiology of shock:*

1. Twenty-nine studies in 10 stations.

F. *Committee on control of hemorrhage* (3 stations).

G. *Committee on fatigue in industrial pursuits:*

1. An investigation of hygienic conditons in industrial establishments.

2. Studies of industrial efficiency.

3. Physiological studies of fatigue.

H. *Committee on Biochemistry:*

1. Studies of varieties of velvet bean and of its utilization as a food.

2. Substitutes for cane sugar.

3. The minimum vitamin requirement.

4. Substitutes for acetone in extracting and drying.

I. *Anthropology committee:*

1. A study of central European races in New York City.

2. Race in relation to physical conditions and fitness for employment.

3. Anthropometric study of drafted men.

J. *Psychology committee:*

1. Twenty studies by 12 different observers (or groups of observers) of military problems to which the methods of psychology are applicable.

K. *Medical zoology:*

1. Studies of Giardia Microti.

2. The treatment of experimental Giardiasis.

3. An improved method of detecting ova of parasites in stools.

4. Hookworm investigations.

5. Louse investigation[1] (3 stations—numerous studies).

[1] Researches in progress under the direction of the Committee on Medicine and Hygiene as constituted in the original organization of the Council (Col. Victor Vaughan, chairman).

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In addition to these more specific activities, the Division has rendered many miscellaneous services, some of which may be briefly stated. Medical and premedical schools have been canvassed, soliciting their cooperation in making certain changes in their curriculum to meet the necessities of war medicine and surgery and the Army Laboratory Service. Letters were sent to all colleges and universities, recommending the character of work best suited for their departments of bacteriology and biology, to fit students for training in the Army Laboratory School in the event of such students being inducted into the Army Laboratory Service. Pathologists and bacteriologists have been procured for the Army Medical Corps.

Conferences between civilian investigators, representatives of the Surgeon General's Office, and the Council have been arranged and the traveling expenses paid in instances where there was no provision by the Government to meet such expense. Bibliographies on medical themes have been prepared and distributed to military hospitals and individuals carrying on war investigations. The cooperation of Col. Garrison, of the Surgeon General's Library, has allowed us to furnish photostatic reprints of articles from German journals published during the war, and in this way it has been possible to disseminate very valuable information in many subjects of importance. Breeding stations for white mice have been organized in different parts of the United States so that the hospital laboratories would not be hampered in pneumonia diagnosis by a lack of these animals. When the present epidemic disease ("influenza") appeared the Division made every effort to assist when and however it could.

Because of the relative independence in the Division of the Psychology Committee and the Committee on Anthropology, special statements prepared by their respective chairmen are given here.

1. *Committee on psychology.*—The Psychology Committee of the Council was appointed in April, 1917, and functioned as an independent committee until it was constituted, in March, 1918, a part of the Division of Medicine and Related Sciences. The committee has worked chiefly through subcommittees and military appointees in the Army and Navy, and the success of its work has been clearly shown by the increase in demands for psychological service and the rapid extension of the several lines of psychological work which have been organized in military departments.

One of the most interesting facts concerning the work of this committee during the war is the great preponderance of service over research. In the numerous reports which have been issued there is much of permanent scientific value, but by contrast the emphasis seems to be placed continuously upon the immediate service of technological materials.

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The services of this section of the Council have touched and more or less modified almost every aspect of military personnel work. The committee on classification of personnel in the Army was indirectly a result of the organization of the psychological military service by the American Psychological Association and the National Research Council.

For the Division of Military Aeronautics the committee has also prepared tests of mental alertness for enlisted men, providing for the measurement of those characteristics of mind and behavior which are important in the aviation service. The contributions of psychologists to the study of qualifications for flying, the fitness of flyers, and the psychological effects of high altitudes are conspicuously important.

The committee has aided the Division of Psychology of the Medical Department of the Army to administer mental tests to enlisted men and commissioned officers in accordance with plans perfected in 1917. This work entailed the establishment of a special school for training in military psychology at Fort Oglethorpe, Ga., in which more than 400 men were trained.

The rating of soldiers according to mental alertness or degree of intelligence has facilitated the early and prompt elimination of men who are mentally unfit for service and the proper utilization of various grades of intelligence. Approximately 1,700,000 individuals have been examined to date.

The establishment by the War Department of the morale branch of the General Staff was greatly facilitated, if not primarily due to the interest and efforts of members of the Psychology Committee.

It has been demonstrated that psychological methods could be devised and adapted to assist in selecting and training observers and scouts, and to this end a series of tests of mental alertness has been prepared for the Division of Military Intelligence.

A special subcommittee was organized to assist the Committee on Education and Special Training of the War Department to adapt instruction in psychology to the needs of the Special Activity Training Camp. Mental tests for the rating of students were also prepared.

For the United States Navy, the Psychology Committee has engaged in the selection of suitable lookouts for merchantmen, the selection of men for special assignment in gunfire squads, and the selection of candidates for training as "listeners." Although the Navy has not utilized the methods of mental testing employed by the Army, assistance has been rendered by this committee to the Navy in connection with the rating, classifying, and assigning of men according to their mental capacity.

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Other investigations have been undertaken dealing with problems whose solution is particularly significant in connection with submarine warfare and aviation and a method has been devised for detecting those men whose emotional constitution is such as to warrant careful neuropsychiatric examination.

Important psychological problems in military training have also been attacked by the committee. A study of disciplinary problems for the assistance of the Medical Department and the morale branch of the General Staff has been undertaken, and much practical work in the interests of mental reeducation has been carried on.

2. *Committees on anthropology.*—Shortly after the organization of the Division, it was recommended by the members of the original Committee on Anthropology to abolish that committee as it was then constituted and to have the anthropological work divided into three sections as they are now represented. It was planned to conduct investigations aimed at perfecting methods of selecting men for and arranging men in military service. A plan of procedure was formulated for making investigations to obtain information that might serve as a basis for further developments in this work. Many of the larger projects in the plan were not realized on account of unexpected and untimely adverse circumstances. However, those investigations planned to be carried on by the individual members of the committee were accomplished, and as a result important recommendations were made to the War Department.

Dr. Davenport was commissioned in the Sanitary Corps of the Army and put in charge of the Section of Anthropology in the Surgeon General's Office, which section was organized along lines suggested by him. In this capacity he made several trips to different camps for the purpose of inspecting methods for making physical examinations, and as a result of such observations changes for improvement were recommended and adopted. The Army standard physical examination form (1010 P. M. G. O.) was revised to include data recording color, occupation, and nationality of registrants. The minimum stature of 63 inches for acceptance in general military service was recommended to be reduced to 60 inches. This change was adopted in June, 1918.

Later Dr. Davenport was put in charge of the statistical work in the Section of Medical Records and at the present time is serving in this office. Very careful examination is being made of data regarding height, weight, chest measurements, and incidence of various defects and diseases found by local draft boards as well as by camp examining boards. These records are being classified with reference to the part of the country from which the individual originates in accordance with a division of the total area of the United States in 157 sections, based primarily upon the racial con-

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stitution of the population of these. Each group of statistics will be treated separately and the results published later. One paper on the relative disease incidence in white and colored troops, by Dr. Davenport and Col. Love, has been sent to the National Academy of Science for publication in its Proceedings.

The plan for securing anthropological information on a broad scale was interfered with first by the temporary abandonment of mobilization when the epidemic disease ("influenza") became so prevalent in September, and following this by the complete cessation of mobilization when hostilities ceased. Despite these facts Dr. Hoffman was able to obtain some records at Hog Island. Plans were presented for carrying on this work during demobilization, but these were not approved by the General Staff.

The financial support for the activities of the Division of Medicine and Related Sciences was obtained from the Rockefeller Foundation. A grant of $50,000 was made to be expended by the Division for war work, although only a relatively small portion of this was used. In addition to this grant, there were two donations made by Maj. W. W. Keen, M. C., of $382.22 and $101.74, royalties from a book entitled "The Treatment of War Wounds," written by Maj. Keen at the suggestion of the Council. Later, when the plans for the Division's activities during demobilization were presented to the Foundation, it made a further grant of $15,000 to support them.

In conclusion, the executive committee of the Medical Division wishes to pay tribute to the many scientific workers throughout the country who have given their services untiringly and unstintingly to the cause for which all have worked during the war. That their efforts have met with success is attested to by many testimonials of thanks and appreciation from the heads of the different divisions of the War, Navy, and Labor Departments whose problems they have endeavored to solve. Also, it wishes to record an expression of appreciation for the thoughtfulness and generosity of Maj. Keen in making his donations to the funds of the Division. The depth of its expression of appreciation to the Rockefeller Foundation can best be stated in acknowledging that without its support any effort to accomplish the purposes of the Division would have been most difficult.

DIVISION OF BIOLOGY.

VERNON KELLOGG, *Chairman;* A. F. WOODS, *Vice Chairman.*

This Division has undertaken primarily to establish the necessary cooperation in handling problems which fall within the scope of its constituent committees. Most of the problems which have been considered are of permanent value and are not confined merely to the period of the war, and many of the investigations will cover a period of several years. Besides initiating various investigations the Division has also provided for the affiliation of individual organizations

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when desirable, such affiliation to cease as soon as the problem in hand has been solved.

Information and suggestions have been furnished to the War Department upon sources of material for making charcoal for gas masks and the possible use of animals as indicators of the presence of poison gases in the air and upon possible uses for ammonium nitrate if this product can be economically manufactured in large nitrate fixation plants.

It has also been ascertained by the Division that other native woods are better suited for airplane propellers than African mahogany, with a result that orders for the importation of this wood were canceled and thousands of tons of shipping thus saved.

In addition, the following projects have been undertaken by this Division:

Fertilizers.—A cooperative group of soil and fertilizer specialists from North and South Dakota, Minnesota, Wisconsin, Iowa, Nebraska, Kansas, and Missouri has been organized for the purpose of studying the fertilizer problems of that great agricultural region and the special cooperation of the Department of Agriculture has been secured for a further study of the problems involved.

Poultry feeding.—Experiments have been carried on to determine the presence or absence in poultry food of certain substances influencing egg production, and a cooperative study among poultrymen in the East and West has been secured. Results so far obtained have confirmed the value of certain empirically established methods of feeding.

Protein metabolism in animal feeding.—Emphasis in this investigation has been placed upon the quality of the protein consumed, the influence of accessory substances and the variation in the ash of the rations. The method of procedure has been to feed beef or dairy calves old enough to consume exclusive dry feed upon two different planes of protein intake but with equal net energy supply. A conference has been arranged to bring together the investigators cooperating in this work, but final results are not as yet available.

Rats, mice, and rodent pests.—In cooperation with the United States Biological Survey a campaign has been started in the United States, through the State Councils of Defense and other organizations, for the rat-proofing of buildings, for cleaning up harboring places, such as trash piles and wooden sidewalks, and for the poisoning of rats. It is estimated that there are over 100,000,000 rats in the United States and that each rat will do at least $2 worth of damage in a year. This campaign, which is continuing, is mainly concerned in drawing attention to the seriousness of the situation. Similarly, in cooperation with the United States Biological Survey, an investigation has been made of the relation of rodent pests

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to their environment, especially with reference to forage and grain crops.

Physiological salt requirements of representative cultivated plants.—A special committee has this subject in charge and various institutions in the country have been visited for the purpose of presenting the problem as an opportunity to cooperate on the application of physiology to agriculture. About half of the standard institutions in the United States are cooperating in the project, and a prospectus has been prepared so that all investigators may follow the same methods and use the same materials.

Sizing materials.—Under the supervision of the United States Bureau of Fisheries a study of the availability of alginic acids for sizing materials has been instituted in view of the scarcity of ordinary sizing materials and the desirability of avoiding any substitute which would decrease the food supply.

Salting fish in southern climates.—Also under the auspices of the United States Bureau of Fisheries, an investigation has been undertaken relative to the possibility of overcoming the processes of decomposition which normally take place in salting fish in southern climates.

Lac and lac insects, mesquite gum.—In view of the existing conditions it seemed that the possibility of developing a domestic source of supply of lac, better known by its commercial name "shellac," should not be neglected. Results showed that in regions where lac is most abundant the supply at present is insufficient for even the most remote commercial possibilities. Mesquite gum was found in negligible quantities.

War emergency board of plant pathologists.—The division has cooperated in the work of propaganda and investigation undertaken by this board, and an appropriation was made to facilitate and encourage the work of the board. The project brought together the leading plant pathologists of the country for the purpose of considering the most effective means of controlling diseases of various food crops, and the results accomplished have not only been of great value from a scientific point of view but from the standpoint of the practical control of diseases as well.

Instruction in universities.—Upon the request of the War Department the Division undertook to formulate courses in biology, protozoology, animals in relation to disease, plant pathology, botanical raw products, and wood inspection for the Students' Army Training Corps. While it is believed that the outlines suggested were helpful in many cases, the continuance of the courses was for so short a period that their value and educational effect could not well be determined. The results of this experience, however, will not be lost.

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PUBLICATIONS.

Hitherto the results of the work of the National Research Council have been widely scattered, appearing in books, reports, articles, in scientific and technical journals, and other publications. The executive board has now decided to issue a series of Bulletins, early numbers of which will contain the following reports and papers:

Report of the Psychology Committee.
Report of the Patent Committee.
Provisional Prospectus of a Zinc Research Association.
Provisional Prospectus of a Ceramics Research Association.
National importance of scientific and industrial research.
Jewett, Frank B.: Industrial Research.
Russell, Henry N.: Some Problems in Sidereal Astronomy.
Washburn, Edward W.: Refractory materials as a field for research.

ACKNOWLEDGMENT.

The chairman of the National Research Council, in concluding nearly three years of service, wishes to express his very cordial appreciation of the unwavering interest in the work of the Council and the steady devotion to its objects which have characterized his many colleagues. Most of them have worked with little or no compensation under the trying conditions of the war emergency, and frequently at great personal inconvenience. The progress that has been made under such circumstances and the unflagging purpose which still animates all who are taking part in the work, even after the war stimulus has been removed, augur well for the future. Special mention should be made of the important contribution of Messrs. Millikan, Noyes, and Merriam, who have served as Acting Chairman during the absence of the Chairman. I wish that it were feasible here to name every one of the hundreds who have aided the Council, both at home and abroad, and to make adequate reference to his or her contribution to the work.[1] Each will find satisfaction in the help given in the prosecution of the war and in preparing the way for the future promotion of research. We have only begun a task of unlimited possibilities, and we may look forward with the keenest interest to its continuation and wide development by our successors.

GEORGE E. HALE, *Chairman.*

REPORT OF THE TREASURER, NATIONAL RESEARCH COUNCIL, FOR THE CALENDAR YEAR 1918.

The work of the National Research Council during 1918 was supported by funds coming from several sources and disbursed in various ways, as indicated in the following statement:

[1] It is expected that detailed reports will be published by the various Divisions of the Council.

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1. Grants from the Carnegie Corporation of New York, through the Carnegie Institution of Washington, for general expenses of office, maintenance, and special investigations, disbursed by the treasurer of the National Research Council from a special account; $50,000 appropriated in June, 1917; $100,000 for the fiscal year July 1, 1918, to June 30, 1919.

2. Grant of $50,000 from the Rockefeller Foundation of New York for the support of the Division of Medicine and Related Sciences for the period from March 1 to December 31. This fund was given to the National Academy of Sciences and has been disbursed by its treasurer from a special account.

3. Miscellaneous funds given to the National Academy of Sciences for the support of the National Research Council.

4. Allotments from the President's emergency appropriation, for general office expenses of the Council, and the expenses of the Research Information Service, disbursed through the Council of National Defense; $29,500 for the period from January 1 to June 30; $61,000 for the period from July 1 to December 31.

5. Special appropriation of $15,000 from the Ordnance Bureau of the War Department for the development of a new type of gun by the National Research Council.

Owing to the various methods of disbursement of the funds the expenditures for the work of the Council during the first six months of 1918 were not completely classified except for the Division of Medicine. A budget system, however, classifying all expenditures and unifying all disbursements for the purpose of a general statement was put into operation on July 1. A summary statement for the last six months under that system is given below.

The divisional expenses are paid by the treasurer on the presentation of accounts duly approved by the chairman of the division concerned and countersigned by the secretary of the Council.

STATEMENT OF RECEIPTS AND DISBURSEMENTS, JAN. 1 TO DEC. 31, 1918.

A summary of all receipts and disbursements for the entire year, arranged in sections corresponding to the main sources of revenue above named, is as follows:

RECEIPTS.

I. Carnegie Corporation fund:		
Jan. 1, balance in bank	$2,619.92	
Amount received in 1918	50,000.00	
		$52,619.92
II. Rockefeller Foundation fund:		
Amount received during year	23,856.82	
Bank interest on deposits	114.25	
		23,971.07

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III. National Academy of Sciences, miscellaneous fund:		
Jan. 1, balance	$2,389.35	
Maj. W. W. Keen, M. C., two donations	483.96	
Interest on investments	51.53	
		$2,924.84
IV. Expenses met by Council of National Defense		70,936.10
V. Expenses met by Bureau of Ordnance, War Department		9,150.42
VI. Refund on account of advances		4,895.53
		164,497.88

DISBURSEMENTS.

I. Grant from Carnegie Corporation	55,580.25
II. Grant from Rockefeller Foundation	15,955.35
III. National Academy of Sciences	
IV. By Council of National Defense	70,936.10
V. By Ordnance Bureau in development of Centrifugal gun	9,150.42
	151,622.12
Balance, Dec. 31	12,875.76
	164,497.88

NOTE.—The disbursements include advances from Research Council funds made under emergency conditions, the amounts being returnable from Government funds. The largest of these advances were in connection with the establishment of the London, Paris, and Rome offices of the Research Information Service.

RECEIPTS AND DISBURSEMENTS FROM JULY 1 TO DEC. 31, 1918.

RECEIPTS.

Appropriations:		
Rockefeller Foundation	$12,433.19	
Carnegie Corporation of New York	30,000.00	
Government—		
National Research Council	28,028.46	
Centrifugal gun	6,739.29	
		$77,200.94
Interest:		
On bank deposits	114.25	
On investments	26.53	
		140.78
Refunds		1,696.42
June 30, 1918, balance		14,571.25
		93,609.39

DISBURSEMENTS.

Divisions:		
General relations	$1,393.03	
Military	7,547.59	
Engineering	16,968.27	
Physics	1,543.42	
Chemistry	4,644.66	
Geology and geography	945.68	
Medicine	14,370.89	
Agriculture	3,346.35	
		50,759.89

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Executive board		$49.68
Contingent		2,346.29
General and office expenses:		
Salaries	$18,439.22	
Office expenses	3,578.62	
Rent, fuel, etc	5,559.93	
		27,577.77
Cash in banks:		
Rockefeller fund	8,015.72	
Carnegie Corporation	1,935.20	
National Academy of Sciences	2,924.84	
		12,875.76
		93,609.39

WAR ORGANIZATION.

AS OF OCTOBER 31, 1918.

OFFICERS.

GEORGE E. HALE.....*Chairman.*
CHARLES D. WALCOTT.....*First Vice Chairman.*
GANO DUNN.....*Second Vice Chairman.*
R. A. MILLIKAN.....*Third Vice Chairman.*
JOHN JOHNSTON.....*Executive Secretary.*
WHITMAN CROSS.....*Treasurer.*
PAUL BROCKETT.....*Assistant Secretary.*
ALFRED D. FLINN.....*Assistant Secretary.*

EXECUTIVE BOARD.

JOHN J. CARTY.....*Chairman.*

Ex-officio members.

Officers of the Council, chairmen, and vice chairmen of divisions; the chairmen of the sections of the General Relations Division.

Elected members.

MARSTON T. BOGERT.
WALTER S. GIFFORD.
VAN H. MANNING.
MICHAEL I. PUPIN.
WILLIAM H. WELCH.
ROBERT S. WOODWARD.

INTERIM COMMITTEE.

A. A. NOYES, *Chairman.*

WHITMAN CROSS.
GANO DUNN.
GEORGE E. HALE.
H. M. HOWE.
JOHN JOHNSTON.
VERNON KELLOGG.
J. C. MERRIAM.
R. A. MILLIKAN.
R. M. PEARCE.
C. D. WALCOTT.

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I. DIVISION OF GENERAL RELATIONS.

A. A. NOYES, *Chairman.*

Advisory Committee.

THEODORE N. VAIL, *Chairman.*

CLEVELAND H. DODGE.
GEORGE EASTMAN.
E. H. GARY.
A. W. MELLON.
PIERRE S. DU PONT.
H. S. PRITCHETT.
EDWIN W. RICE, JR.
ELIHU ROOT.
AMBROSE SWASEY.

Sections:

FOREIGN RELATIONS, GEORGE E. HALE, *Chairman.*

INDUSTRIAL RESEARCH, JOHN JOHNSTON, *Chairman.*

RELATIONS WITH EDUCATIONAL INSTITUTIONS AND STATE COMMITTEES, J. C. MERRIAM, *Chairman.*

Committees:

PATENT OFFICE COMMITTEE, L. H. BAEKELAND, *Acting Chairman.*

COMMITTEE ON RECONSTRUCTION PROBLEMS, VERNON KELLOGG, *Chairman;* F. H. NEWELL, *Vice Chairman.*

SPECIAL COMMITTEE ON EDUCATION AND SPECIAL TRAINING, J. C. MERRIAM, *Chairman.*

II. MILITARY DIVISION.

CHARLES D. WALCOTT, *Chairman,* Secretary, Smithsonian Institution.

S. W. STRATTON, *Vice Chairman,* Director, United States Bureau of Standards.

CARL L. ALSBERG, Chief, Bureau of Chemistry, United States Department of Agriculture.

WILLIAM S. BENSON, Admiral, United States Navy, Chief of Naval Operations.

WILLIAM S. BLACK, Major General, United States Army, Chief of Engineers.

MARLBOROUGH CHURCHILL, Brigadier General, United States Army, Division of Military Intelligence.

RALPH EARLE, Rear Admiral, United States Navy, Chief, Bureau of Ordnance.

WALTER S. GIFFORD, Director, Council of National Defense.

WILLIAM C. GORGAS, Major General, United States Army, Surgeon General.

ROBERT S. GRIFFIN, Rear Admiral, United States Navy, Engineer in Chief.

HENRY S. GRAVES, Chief, Forest Service, United States Department of Agriculture.

P. D. LOCKRIDGE, Brigadier General, United States Army, Head of Division of War Plans, General Staff.

VAN H. MANNING, Director, United States Bureau of Mines.

CHARLES F. MARVIN, Chief, United States Weather Bureau.

WILLIAM L. SIBERT, Major General, United States Army, Director of Chemical Warfare Survey.

GEORGE O. SMITH, Director, United States Geological Survey.

GEORGE O. SQUIER, Major General, United States Army, Chief Signal Officer.

DAVID W. TAYLOR, Rear Admiral, United States Navy, Chief Constructor.

ROGER WELLES, Rear Admiral, United States Navy, Director of Naval Intelligence.

CLARENCE C. WILLIAMS, Brigadier General, United States Army, Chief of Ordnance.

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RESEARCH INFORMATION SERVICE.

PRESENT ORGANIZATION.

COMMITTEE IN CHARGE:

The Chief of the Division of Military Intelligence, Brig. Gen. MARLBOROUGH CHURCHILL.

The Director of Naval Intelligence, Rear Admiral ROGER WELLES.

The chairman of the National Research Council, or representative designated by him, who acts as general executive officer of the Research Information Service.

WASHINGTON BRANCH:

Officers:

Executive secretary, GRAHAM EDGAR.
Representative of physics and engineering, F. C. BLAKE.
Representative of chemistry and chemical technology, GRAHAM EDGAR
Representative of medicine and related sciences, R. M. PEARCE.

Representatives of Army bureaus:

Division of Military Aeronautics, Capt. A. AMES.
Military Intelligence, Capt. CARL KINSLEY.
Bureau of Ordnance, Maj. C. J. BROWNE.
Quartermaster General's Office, Maj. W. F. DODD.
Office of the Signal Corps, Capt. G. F. GRAY.
Chemical Warfare Service, Maj. S. P. MULLIKEN.
Tank Corps, Capt. PHIL D. POSTON.
Engineer Corps, Capt. L. D. ROWELL.
Office of Surgeon General, Col. F. F. RUSSELL.

Representatives of Navy bureaus:

Office of Naval Intelligence, Lieut. Commander H. H. WHITTLESEY.
Bureau of Steam Engineering, Lieut. M. PENDLETON.
Bureau of Construction and Repair, Capt. W. G. DUBOSE.
Operations—Aviation, Ensign A. F. LIPPMANN.
Bureau of Ordnance, Ensign C. L. MCCREA.

Representatives of civilian bureaus:

War Industries Board, ———.
National Advisory Committee for Aeronautics, W. C. SABINE.
Bureau of Standards, F. J. SCHLINK.
Bureau of Mines, F. G. COTTRELL.
Bureau of Chemistry, H. D. GIBBS.
Explosive Investigations Committee, C. E. MUNROE.
Nitrate Investigations Committee, JOHN JOHNSTON.

Representatives of foreign missions:

British Embassy and war mission.
French Embassy and war mission.
Italian Embassy and war mission.
Japanese Embassy and war mission.
Canadian war mission.

LONDON BRANCH: The military attaché; the naval attaché; the scientific attaché, H. A. BUMSTEAD; engineering associate, S. J. FARNSWORTH; chemical associate, ——.

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PARIS BRANCH: The military attaché; the naval attaché; the scientific attaché, W. F. DURAND; physical associate, K. T. COMPTON; chemical associate, ——; medical associate, R. G. PERKINS.

ROME BRANCH: The military attaché; the naval attaché; the scientific attaché, S. L. G. KNOX; physical associate, EDGAR BUCKINGHAM; chemical associate, H. S. WASHINGTON.

III. DIVISION OF ENGINEERING.

HENRY M. HOWE, *Chairman.*
W. J. LESTER, *Vice Chairman.*

EXECUTIVE COMMITTEE.

C. A. ADAMS.
HENRY M. HOWE.
W. J. LESTER.
L. S. MARKS.
K. E. STUART.
BRADLEY STOUGHTON.

ADVISORY COMMITTEE.

ARTHUR A. HAMMERSCHLAG,	Officially representing the	General Staff, United States Army.
VAN H. MANNING,		United States Bureau of Mines.
POPE YEATMAN,		War Industries Board.
D. W. BRUNTON,		Naval Consulting Board.
AMBROSE SWASEY,		Engineering Foundation.
GEORGE S. WEBSTER,		American Society of Civil Engineers.
PHILIP N. MOORE,		American Institute of Mining Engineers.
JOHN R. FREEMAN,		American Society of Mechanical Engineers.
C. A. ADAMS,		American Institute of Electrical Engineers.
A. A. STEVENSON,		American Society for Testing Materials.
W. B. PRICE,		American Institute of Metals.
EDWARD P. HYDE,		Illuminating Engineering Society.

W. H. BURR.
GANO DUNN.
F. B. JEWETT.
L. B. STILLWELL.
GEORGE C. STONE.
W. R. WALKER.

F. M. WARING.

SECTIONS.

1. Prime movers, L. S. MARKS, *Chairman.*
2. Mechanical engineering, W. J. LESTER, *Chairman.*
   Committee: Fatigue of metals, H. F. MOORE, *Chairman.*
3. Metallurgy, BRADLEY STOUGHTON, *Chairman.*
   Committees:
   - Helmets and body armor, Maj. BASHFORD DEAN, *Chairman.*
   - Ferroalloys, J. E. JOHNSON, Jr., *Chairman.*
   - Steel ingot, Lieut. Col. WILLIAM P. BARBA, *Chairman.*
   - Pyrometer, GEORGE K. BURGESS, *Chairman.*
   - Improvement of metals by treatment at blue heat, ZAY JEFFRIES, *Chairman.*
4. Electrical engineering, C. A. ADAMS, *Chairman.*
   Committee jointly under metallurgy and electrical engineering: Electric welding research, H. M. HOBART, *Chairman.*

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IV. DIVISION OF PHYSICS, MATHEMATICS, ASTRONOMY, AND GEOPHYSICS.

R. A. MILLIKAN, *Chairman.*
C. E. MENDENHALL, *Vice Chairman.*

EXECUTIVE COMMITTEE.

Physics.—J. S. AMES, C. E. MENDENHALL, R. A. MILLIKAN, E. F. NICHOLS, W. C. SABINE, S. W. STRATTON.
Astronomy.—H. N. RUSSELL, FRANK SCHLESINGER.
Geophysics.—L. A. BAUER, A. L. DAY, C. F. MARVIN.
Mathematics.—F. R. MOULTON, R. S. WOODWARD.

COMMITTEES.

1. Physics committee, R. A. MILLIKAN, *Chairman.*
   Subcommittees:
   - Airplane instruments, C. E. MENDENHALL.
   - Arc-light problems, C. G. ABBOT.
   - Balloon problems, H. N. DAVIS.
   - Bomb sights and stabilizers, A. W. DUFF.
   - Camouflage, M. LUCKIESH.
   - Crystal detectors, WALTER G. CADY.
   - Illumination, J. T. TATE.
   - Location of invisible aircraft, G. W. STEWART.
   - Location of mining and tunneling operations, H. A. WOOD.
   - Monoculars and binoculars, E. P. HYDE.
   - Muzzle velocity of projectiles, PAUL KLOPSTEG.
   - Naval range finders, A. A. MICHELSON.
   - Navigation of airplanes, H. N. RUSSELL.
   - Optical signaling, R. W. WOOD.
   - Parachute problems, W. J. LESTER.
   - Photo receiving, JOEL STEBBINS.
   - Pressures in sound waves, D. C. MILLER.
   - Range finders for antiaircraft service, G. B. PEGRAM.
   - Sound ranging, E. B. ROSA.
   - Static charges on airships, G. S. FULCHER.
   - Submarine investigations (several groups), ERNEST MERRITT, MAX MASON, M. I. PUPIN, H. J. RYAN.
   - Submarine mines, E. F. NICHOLS.
   - Upper-air problems, W. R. BLAIR.
   - Use of high pressure in manufacturing guns, P. W. BRIDGMAN.
   - Visibility, F. A. SAUNDERS.
   - Wireless, F. B. JEWETT.
2. Mathematics committee, E. H. MOORE, *Chairman.*
3. Astronomy committee, E. C. PICKERING, *Chairman;* H. N. RUSSELL, *Vice Chairman.*
4. Commiteee on optical glass, A. L. DAY, *Chairman.*
5. Committee on navigation and nautical instruments, L. A. BAUER, *Chairman.*

V. DIVISION OF CHEMISTRY AND CHEMICAL TECHNOLOGY.

JOHN JOHNSTON, *Chairman.*
E. W. WASHBURN, *Vice Chairman.*

H. D. GIBBS, Bureau of Aircraft Production.
C. L. ALSBERG, Bureau of Chemistry.

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C. L. PARSONS, Bureau of Mines.
W. F. HILLEBRAND, Bureau of Standards.
W. D. BANCROFT, E. P. KOHLER, A. B. LAMB, Chemical Warfare Service, research division.
M. T. BOGERT, S. A. TUCKER, Chemical Warfare Service.
A. A. NOYES, nitrate division, Ordnance Department.
GRAHAM EDGAR, research information service.
WILLIS R. WHITNEY, research laboratory, General Electric Co.

COMMITTEE ON NITRATE INVESTIGATIONS, APPOINTED AT THE REQUEST OF THE SECRETARY OF WAR.

A. A. NOYES, *Chairman.*
JOHN JOHNSTON.
A. H. WHITE (lieutenant colonel, nitrate division, Ordnance Department).

COMMITTEE ON EXPLOSIVES INVESTIGATIONS, APPOINTED AT THE REQUEST OF THE SECRETARIES OF WAR AND NAVY.

CHARLES E. MUNROE, *Chairman.*
W. C. SPRUANCE, jr., lieutenant colonel, Ordnance Department.
L. L. SUMMERS, War Industries Board.
T. S. WILKINSON, lieutenant commander, United States Navy.

SPECIAL COMMITTEES.

1. Chemical apparatus and supplies, ARTHUR H. THOMAS, *Chairman.*
2. Chemistry of ceramics, EDWARD W. WASHBURN, *Chairman.*
3. Chemistry of textiles and fabrics, J. MERRITT MATHEWS, *Chairman.*
4. Chemistry and technology of glass, ARTHUR L. DAY, *Chairman.*
5. Chemistry of fuels, E. R. WEIDLEIN, *Chairman.*
6. Chemistry of colloids, JEROME ALEXANDER, *Chairman.*
7. Chemistry of soils and fertilizers, HOMER J. WHEELER, *Chairman.*
8. Synthetic drugs, JULIUS STIEGLITZ, *Chairman.*
9. Chemical engineering, CHARLES F. MCKENNA, *Chairman.*
10. Chemistry of rubber and allied substances, DAVID SPENCE, *Chairman.*

SPECIAL CONSULTANTS.

1. Analytical chemistry, WILLIAM F. HILLEBRAND.
2. Carbohydrate chemistry, CLAUDE S. HUDSON.
3. Chemistry of cellulose and paper, ARTHUR D. LITTLE.
4. Chemistry of cements and related building materials, PREVOST HUBBARD.
5. Chemistry of explosives, ARTHUR M. COMEY.
6. Chemistry of fats, fatty oils, and soap, MARTIN H. ITTNER.
7. Food chemistry, CARL L. ALSBERG.
8. Chemistry of forest products, JOHN E. TEEPLE.
9. Chemistry of leather and tanning, ALLEN ROGERS.
10. Mineralogical and geological chemistry, FRANK W. CLARKE.
11. Chemistry of paints, varnishes, and resins, HENRY A. GARDNER.
12. Pharmaceutical chemistry, FREDERICK B. POWER.

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VI. DIVISION OF GEOLOGY AND GEOGRAPHY.

JOHN C. MERRIAM, *Chairman.*
WHITMAN CROSS, *Vice Chairman.*

EXECUTIVE COMMITTEE.

ISAIAH BOWMAN.
WHITMAN CROSS.
F. W. DE WOLF.
H. E. GREGORY.
DOUGLAS W. JOHNSON.
LAWRENCE MARTIN.
JOHN C. MERRIAM.
P. S. SMITH.
J. E. SPURR.

COMMITTEES.

1. Geology and paleontology committee, JOHN M. CLARKE, *Chairman.*
2. Geography committee, W. M. DAVIS, *Chairman.*
3. Committee on study of possible contribution of geology and geography to military training, C. P. BERKEY, *Chairman.*
4. Committee on emergency courses of instruction in Geology and geography in educational institutions, HERBERT E. GREGORY, *Chairman.*
5. Committee on special lectures on geologic and geographic subjects at military camps.
6. Committee on quartz resources, G. P. MERRILL, *Chairman.*

VII. DIVISION OF MEDICINE AND RELATED SCIENCES.

R. M. PEARCE, *Chairman.*
PEYTON ROUS, *Vice Chairman.*

EXECUTIVE COMMITTEE.

R. I. COLE.
H. D. DAKIN.
C. B. DAVENPORT.
W. H. HOWELL.
SIMON FLEXNER.
C. H. MAYO.
W. J. MAYO.
R. M. PEARCE.
PEYTON ROUS.
F. F. RUSSELL.
E. R. STITT.
V. C. VAUGHAN.
W. H. WELCH.
R. M. YERKES.

COMMITTEES.

1. Anatomy committee, C. R. STOCKARD, *Chairman.*
2. Physiology committee, W. B. CANNON, *Chairman;* W. H. HOWELL, *Vice chairman* and *Acting chairman.*
   Subcommittees:
   Fatigue in industrial pursuits, FREDERICK S. LEE, *Chairman.*
   Investigations on the physiology of shock, W. B. CANNON, *Chairman.*
   Control of hemorrhage, W. H. HOWELL, *Chairman.*
3. Committee on medicine and hygiene, VICTOR C. VAUGHAN, *Chairman.*
   Subcommittees:
   Standardization of transfusion methods, PEYTON ROUS, *Chairman.*
   Treatment of chronic anemia, GEORGE H. WHIPPLE, *Chairman.*
4. Committee on neurology and psychiatry, STEWART PAYTON, *Chairman;* E. E. SOUTHARD, *Acting chairman;* S. T. ORTON, *Vice chairman.*

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5. Psychology committee, ROBERT M. YERKES, *Chairman;* JOHN W. BAIRD, *Vice chairman.*
   Subcommittees:
   Problems of aviation, EDWARD L. THORNDIKE, *Chairman.*
   Problems of reeducation, SHEPHERD I. FRANZ, *Chairman.*
   Visual problems, RAYMOND DODGE, *Chairman.*
   Psychological and pedagogical aspects of military training and discipline, WILLIAM C. BAGLEY, *Chairman.*
   Emotional fitness for warfare, R. S. WOODWORTH, *Chairman.*
   Acoustic problems of military importance, C. E. SEASHORE, *Chairman.*
   Adaptation of psychological instruction to military educational needs, RAYMOND DODGE, *Chairman.*
6. Anthropology committees:
   Anthropometry in the Army, CHARLES B. DAVENPORT, *Chairman.*
   Race in relation to disease:
   (1) Military records, A. G. LOVE, *Chairman.*
   (2) Civilian records, F. L. HOFFMAN, *Chairman.*
7. Committees on medical zoology:
   Entomology, L. O. HOWARD, *Chairman.*
   Helminthnology, H. B. WARD, *Chairman.*
   Protozoology, C. A. KOFOID, *Chairman.*
8. Committee on biochemistry, F. P. UNDERHILL, *Chairman.*
9. Advisory committee on toxicity of preserved foods, J. J. ABEL, *Chairman.*
10. Committee on industrial poisoning, H. G. WELLS, *Chairman.*

VIII. DIVISION OF AGRICULTURE, BOTANY, FORESTRY, ZOOLOGY, AND FISHERIES.

VERNON KELLOGG, *Chairman.*
A. F. WOODS, *Vice Chairman.*

EXECUTIVE COMMITTEE.

OAKES AMES.
I. W. BAILEY.
E. M. EAST.
KARL KELLERMAN.
VERNON KELLOGG.
B. E. LIVINGSTON.
C. E. MCCLUNG.
H. F. MOORE.
A. F. WOODS.
RAPHAEL ZON.

COMMITTEES.

1. Agriculture, A. F. WOODS, *Chairman.*
2. Botany, JOHN M. COULTER, *Chairman.*
3. Botanical raw products, E. M. EAST, *Chairman.*
4. Zoology, C. E. MCCLUNG, *Chairman.*
5. Fisheries, H. F. MOORE, *Representative.*
6. Forestry, RAPHAEL ZON, I. W. BAILEY, *Representatives.*

SPECIAL COMMITTEES.

1. Fibers, E. M. EAST, *Chairman.*
2. Protein metabolism in animal feeding, H. P. ARMSBY, *Chairman.*
3. Physiological salt requirements of certain cultivated plants, BURTON E. LIVINGSTON, *Chairman.*

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Special joint committee on fertilizer investigations.—A. F. Woods (*Chairman*), E. W. Allen, F. J. Alway, Samuel Avery, Karl Kellerman, J. G. Lipman, Burton E. Livingston, William W. Means.

ORGANIZATION OF THE NATIONAL RESEARCH COUNCIL.

Adopted February 11, 1919, by the Council of the National Academy of Sciences.

PREAMBLE.

The National Academy of Sciences, under the authority conferred upon it by its charter, enacted by Congress, and approved by President Lincoln on March 3, 1863, and pursuant to the request expressed in an Executive Order made by President Wilson on May 11, 1918, hereto appended, adopts the following permanent organization for the National Research Council, to replace the temporary organization under which it has operated heretofore.

ARTICLE I. PURPOSE.

It shall be the purpose of the National Research Council to promote research in the mathematical, physical, and biological sciences, and in the application of these sciences to engineering, agriculture, medicine, and other useful arts, with the object of increasing knowledge, of strengthening the national defense, and of contributing in other ways to the public welfare, as expressed in the Executive Order of May 11, 1918.

ARTICLE II. MEMBERSHIP.

Section 1. The membership of the National Research Council shall be chosen with the view of rendering the Council an effective federation of the principal research agencies in the United States concerned with the fields of science and technology named in Article I.

Section 2. The Council shall consist of—

1. Representatives of national scientific and technical societies;
2. Representatives of the Government, as provided in the Executive Order;
3. Representatives of other research organizations and other persons whose aid may advance the objects of the Council.

ARTICLE III. DIVISIONS.

Section 1. The Council shall be organized in Divisions of two classes: (*a*) Divisions dealing with the more general relations and activities of the Council; (*b*) Divisions dealing with related branches of science and technology.

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Section 2. The initial constitution of the Divisions of the Council shall be as follows:

(*a*) Divisions of General Relations:

I. Government Division.
II. Division of Foreign Relations.
III. Division of States Relations.
IV. Division of Educational Relations.
V. Division of Industrial Relations.
VI. Research Information Service.

(*b*) Divisions of Science and Technology:

VII. Division of Physical Sciences.
VIII. Division of Engineering.
IX. Division of Chemistry and Chemical Technology.
X. Division of Geology and Geography.
XI. Division of Medical Sciences.
XII. Division of Biology and Agriculture.
XIII. Division of Anthropology and Psychology.

Section 3. The number of divisions and the grouping of subjects in Article III, section 2, may be modified by the Executive Board of the National Research Council.

Section 4. The Divisions of General Relations shall be organized by the Executive Board of the National Research Council (Article IV, section 2).

Section 5. To secure the effective federation of the principal research agencies in the United States, provided for in Article II, a majority of the members of each of the Divisions of Science and Technology shall consist of representatives of scientific and technical societies, chosen as provided for in Article V, section 2. The other members of the Division shall be nominated by the Executive Committee of the Division, approved by the Executive Board of the National Research Council, and appointed in accordance with Article V, section 4.

Section 6. The Divisions of the Council, with the approval of the Executive Board, may establish sections and committees, any of which may include members chosen outside the membership of the Council.

ARTICLE IV. ADMINISTRATION.

Section 1. The affairs of each Division shall be administered by a Chairman, a Vice-Chairman, and an Executive Committee, of which the Chairman and the Vice-Chairman shall be ex-officio members; all of whom shall be elected annually by the Division and confirmed by the Executive Board.

Section 2. The affairs of the National Research Council shall be administered by an Executive Board, of which the officers of the

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Council, the President and Home Secretary of the National Academy of Sciences, the President of the American Association for the Advancement of Science, the Chairmen and the Vice-Chairmen of the Divisions of Science and Technology, and the Chairmen of the Divisions of General Relations shall be ex-officio members. The Executive Board may elect additional members, not to exceed ten in number, who, if not already members of the National Research Council, shall be appointed thereto, in accordance with Article V, section 4.

Section 3. The officers of the National Research Council shall consist of a Chairman, one or more Vice-Chairmen, a Secretary and a Treasurer, who shall also serve as members and officers of the Executive Board of the Council.

Section 4. The officers of the National Research Council, excepting the Treasurer, shall be elected annually by the Executive Board. The Treasurer of the National Academy of Sciences shall be ex-officio Treasurer of the National Research Council.

Section 5. The duties of the officers of the Council and of the Divisions shall be fixed by the Executive Board.

ARTICLE V. NOMINATIONS AND APPOINTMENTS.

Section 1. Government bureaus, civil and military, to be represented in the Government Division, and the scientific and technical societies, to be represented in the Divisions of Science and Technology of the National Research Council, shall be determined by joint action of the Council of the National Academy of Sciences and the Executive Board of the National Research Council.

Section 2. Representatives of scientific and technical societies shall be nominated by the societies, at the request of the Executive Board, and appointed by the President of the National Academy of Sciences to membership in the Council and assigned to one of its divisions.

Section 3. The representatives of the Government shall be nominated by the President of the National Academy of Sciences after conference with the Secretaries of the Departments concerned, and the names of those nominated shall be presented to the President of the United States for designation by him for service with the National Research Council.

Section 4. Other members of the Council shall be nominated by the Executive Committees of the Divisions, approved by the Executive Board and appointed by the President of the National Academy of Sciences to membership and assigned to one of the divisions.

Section 5. Prior to the first annual meeting of the Council following January 1, 1919, all Divisions shall be organized by appointment of their members in accordance with Article II and Article V, sections 1 to 4.

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Section 6. As far as practicable, one-third of the original representatives of each scientific and technical society and approximately one-third of the other original members of each of the Divisions of Science and Technology shall serve for a term of three years; one-third for a term of two years, and one-third for a term of one year, their respective terms to be determined by lot. Each year thereafter, as the terms of members expire, their successors shall be appointed for a period of three years.

Section 7. The Government representatives shall serve for periods of three years, unless they previously retire from the Government office which they represent, in which case their successors shall be appointed for the unexpired term.

Section 8. As far as practicable, a similar rotation shall be observed in the appointment of the members of the Divisions of General Relations.

ARTICLE VI. MEETINGS.

Section 1. The Council shall hold one stated meeting, called the annual meeting, in April of each year, in the city of Washington, on a date to be fixed by the Executive Board. Other meetings of the Council shall be held on call of the Executive Board.

Section 2. The Executive Board and each of the Divisions shall hold an annual meeting, at which officers shall be elected, at the time and place of the annual meeting of the Council, unless otherwise determined by the Executive Board and such other meetings as may be required for the transaction of business.

Section 3. Joint meetings of the Executive Board of the National Research Council and the Council of the National Academy of Sciences shall be held from time to time, to consider special requests from the Government, the selection of organizations to be represented in the National Research Council, and other matters which, in the judgment of the President of the National Academy, require the attention of both bodies.

ARTICLE VII. PUBLICATIONS AND REPORTS.

Section 1. An annual report on the work of the National Research Council shall be presented by the Chairman to the National Academy of Sciences, for submission to Congress in connection with the annual report of the President of the Academy.

Section 2. Other publications of the National Research Council may include papers, bulletins, reports, and memoirs, which may appear in the Proceedings or Memoirs of the National Academy of Sciences, in the publications of other societies, in scientific and technical journals, or in a separate series of the Research Council.

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ANNUAL REPORT OF THE TREASURER.

JANUARY 1 TO DECEMBER 31, 1918.

To the PRESIDENT OF THE NATIONAL ACADEMY OF SCIENCES:

I have the honor to submit the following report as treasurer for the fiscal year January 1 to December 31, 1918. Some of the items of general interest will be mentioned before presenting details.

The volume of financial transactions, apart from investments, is indicated by the statement that the income of the academy from dues, interest on investments, subscriptions to the Proceedings, contributions to Proceedings fund, and the William Ellery Hale lectureship was $15,912.86, while the miscellaneous disbursements amounted to $9,596.74, and payments on grants from trust funds and for medals were $3,600.66.

The sum of investments held by the academy on December 31 was $257,761, yielding on that date at the rate of 5.27 per cent.

Changes in investments may be summarized as follows: Loans on real estate aggregating $7,250 were paid, and loans amounting to $16,000 were renewed at increased rates of interest; one new note was purchased at $1,500. Bonds of the face value of $21,200 were purchased for $19,727.50.

In accordance with the action of the academy in November, 1916, the capital of the Marsh fund was increased to $19,000 through the addition to it of interest on the deferred payments of the bequest from Prof. O. C. Marsh, received in 1916, and by transfer of accumulated income. By the addition of further increments of $500 annually from income this fund will, on February 1, 1920, reach the total of $20,000 authorized by the academy.

A further payment of $2,500 was received from the executors of the estate of Mrs. Mary Anna Palmer Draper toward the total of $25,000 bequeathed to the academy by Mrs. Draper in 1915 to establish the Billings fund.

The sum of $3,000 was added to the Bache fund from accumulated income on February 1, 1918, in accordance with the directions of the directors.

The sum of $23,856.82 was received toward defraying expenses of the division of medicine and related sciences of the National Research Council from a total appropriation of $50,000 from the Rockefeller

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Foundation, and $15,955.35 was expended for that purpose. This fund was handled through a special bank account.

The consolidated investment fund reached a total of $181,895.50 by the additions during the year to the Bache and Billings funds.

Through Maj. W. W. Keen, M. C., of Philadelphia, a contribution was made to the National Research Council of $483.96 for the use of the division of medicine and related sciences, from the royalties on a book which he had published, entitled "Treatment of War Wounds."

TRUST FUNDS OF THE ACADEMY.

The trust funds of the academy, the income of which is administered for specific purposes, are enumerated below. The capital of certain funds has been increased beyond the amount of the original gift or bequest, by the transfer of accumulated income, at the request of the donors or by action of the academy.

Bache fund: Bequest of Alexander Dallas Bache, a member of the academy, 1870. To aid researches in physical and natural sciences	$59,000.00
Watson fund: Bequest of James C. Watson, a member of the academy, 1874. For the promotion of astronomical science through the award of the Watson gold medal and grants of money in aid of research	25,000.00
Draper fund: Gift of Mrs. Henry Draper, 1883. In memory of her husband, a former member of the academy. To found the Henry Draper gold medal, to be awarded for notable investigations in astronomical physics. The balance of income is applied to aid research in the same science	10,000.00
Smith fund: Gift of Mrs. J. Lawrence Smith, 1884, in memory of her husband, a former member of the academy. To found the J. Lawrence Smith gold medal, to be awarded for important investigations of meteoric bodies and to assist, by grants of money, researches concerning such objects	10,000.00
Gibbs fund: Established by gift of Wolcott Gibbs, a member of the academy, 1892, and increased by a bequest of the late Morris Loeb, 1914. For the promotion of researches in chemistry	5,545.50
Gould fund: Gift of Miss Alice Bache Gould, 1897, in memory of her father, a former member of the academy. For the promotion of researches in astronomy	20,000.00
Comstock fund: Gift of Gen. Cyrus B. Comstock, a member of the academy, 1907. To promote researches in electricity, magnetism, or radiant energy, through the Comstock prize, of money, to be awarded once in five years for notable investigations. The fund is to be increased ultimately to $15,000	12,406.02
Marsh fund: Bequest of Othniel Charles Marsh, a member of the academy, 1909. To promote original research in the natural sciences. To the original bequest of $10,000 the academy has added interest received from the estate and authorized the increase of the fund to $20,000 by annual additions from income	19,000.00

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Murray fund: A gift from Sir John Murray, 1911, to found the Alexander Agassiz gold medal, in honor of a former member and president of the academy, to be awarded for original contributions to the science of oceanography $6,000.00

Hartley fund: A gift from Mrs. Helen Hartley Jenkins, 1913–14, in memory of her father, Marcellus Hartley, to found the medal of the academy awarded for eminence in the application of science to the public welfare 1,200.00

Billings fund: Established by the bequest of Mrs. Mary Anna Palmer Draper (Mrs. Henry Draper) of $25,000, 1915. To support the publication of the Proceedings of the academy or for other purpose to be determined by the academy. Three installments 5,000.00

Elliot fund: Gift of Margaret Henderson Elliot to found the Daniel Giraud Elliot gold medal and honorarium, for the most meritorious work in zoology or palaeontology published in each year 8,000.00

In addition to the above-named funds the academy holds the following:

Agassiz fund: Bequest of Alexander Agassiz, a member of the academy, 1910, for the general uses of the academy $50,000.00

Building fund: A gift from Alexander Agassiz and Theodore N. Gill, former members of the academy, toward a building for the academy, together with accumulated income 9,400.00

STATEMENTS OF ASSETS AND LIABILITIES, DECEMBER 31, 1918.

ASSETS.

1. Mortgage notes, secured by first mortgages on real estate		$80,000.00
2. Bonds, giving name, face value, rate of interest, and cost:		
5 American Telephone & Telegraph Co. 30-year, 5 per cent, gold collateral trust 5's, due Dec. 1, 1946. 5 at $1,000. Nos. 640, 4604, 29245, 29246, 41419	$4,752.50	
5 Asheville Power & Light Co., first mortgage 30-year gold, 5 per cent, due Apr. 1, 1942, New York. 5 at $1,000. Nos. 272, 490, 492, 508, 509	4,892.50	
12 Broadway Realty Co., purchase money, first 5 per cent gold, due Sept. 1, 1926. 12 at $1,000. Nos. 38, 50, 796, 963–5, 1068, 1616–20	12,345.00	
10 Bush Terminal Buildings Co., first mortgage 50-year sinking fund, 5 per cent gold, due Apr. 1960. 10 at $1,000. Nos. 1383–1387 and 2805–2809	9,375.00	
5 Chesapeake & Ohio, general mortgage, 4.5's gold, due New York, Mar. 1, 1992. 5 at $1,000. Nos. 15350, 15351, 15352, 15353, 15354	4,600.00	
4 City of Tacoma, Green River special water fund No. 2. 5 per cent. due Oct. 1, 1939. 4 at $1,000. Nos. 1508, 1509, 1510, 1511	4,140.00	
12 Cleveland Electric & Illuminating Co., first mortgage, 5 per cent gold, due New York, Apr. 1, 1939. 4 at $500 and 8 at $1,000. Nos. M6060, M6096, M6097, M15094–15098, D261–264	9,597.50	

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2. Bonds, etc.—Continued.

18 Cosmos Club, 4.5 per cent, due July 1, 1949. 18 at $1,000. Nos. 286–7–8–9, 290–1–2–3–4, 296–7, 299, 301–2–3–4–5, 350	$18,000.00
9 Detroit Edison Co., 5's, first mortgage, 30-year, gold, due Jan. 1, 1933. 10 at $1,000. Nos. 557, 2442, 2443, 3024, 3252, 3253, 3639–3641, 8086	10,072.50
6 Detroit Edison Co., first and refunding mortgage, gold, 5's, due Jan. 1, 1940. 4 at $1,000; 3 at $500. Nos. 9657–8–9–60, D501, D502, D599	5,005.00
4 Dominion Coal Co. (Ltd.), first mortgage, sinking-fund gold, 5 per cent, due New York, May 1, 1940. 4 at $1,000. Nos. A1037–A1040	4,675.00
8 Galveston, Harrisburg & San Antonio, Mexican & Pacific Ex., 6 per cent second guaranteed reduced to 5 per cent due Jan. 1, 1931. 8 at $1,000. Nos. 1044, 1048, 1248, 2112–2116	8,030.00
2 Georgia Ry. & Electric Co., first consolidated mortgage, 5's, sinking-fund gold, due Jan. 1, 1932. 2 at $1,000. Nos. 1061, 1600	2,055.00
13 Government of the Province of Alberta 4.5 per cent, 10-year gold debenture, due New York, Dec. 1, 1923. 11 at $100, Nos. 1501–1511; 2 at $500, Nos. 2031, 2032, $2,100	2,008.50
6 Government of the Province of Alberta, 5 per cent, 10-year gold debenture, due New York, May 1, 1925. 1 at $1,000, No. 2364; 5 at $500, Nos. 0189B–0193B; $3,500	3,373.75
1 Government of the Province of Alberta, 4.5 per cent, 10-year gold debenture, due New York, Feb. 1, 1924, 1 at $500. No. 2620	480.00
4 Grand Rapids Gas Light Co., 5 per cent, first mortgage, gold, due New York, Aug. 1, 1939. 4 at $1,000. Nos. A522, A523, A595, A596	4,020.00
1 Hydraulic Power Co. of Niagara Falls, 5 per cent refunding and improvement mortgage, due Oct. 1, 1951. 2 at $500. Nos. D457, D458	890.00
35 Liberty, third loan, 4¼ per cent gold of 1928. 25 at $100. Nos. 1,049.788 to 1,049,800, 1,050,701 to 1,050,712; 10 at $50. Nos. 1,886,579 to 1,886,588	3,000.00
2 Liberty, fourth loan, 4¼ per cent gold of 1933–1938. 2 at $100. Nos. 2,566,501–2	200.00
9 Milwaukee Electric Railway & Light Co., 5 per cent general and refunding mortgage gold, series A, due New York, Dec. 1, 1951. 9 at $1,000. Nos. 2088, 2772, 3830, 3840, 3930, 3931, 5222, 5223, 5224	8,237.50
10 Minneapolis General Electric Co., 5 per cent, 30-year gold-mortgage, due New York, Dec. 1, 1934. 10 at $1,000. Nos. 1621, 1622, 1949, 2004, 2572, 2573, 2574, 2575, 7579, 7580	9,880.00

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2. Bonds, etc.—Continued.		
4 Niagara Falls Power Co., first mortgage 5's, gold coupon, due Jan. 1, 1932. 4 at $1,000. Nos. 5246, 5247, 6583, 8358	$4,100.00	
14 Riggs Realty Co., 3/30-year coupon, first 5's due Washington, D. C., Oct. 1, 1940. 14 at $1,000. Nos. 92, 96, 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140, 144	14,532.50	
10 Shawinigan Water & Power Co., 5 per cent consol. mortgage 30-year, gold, due Jan. 1, 1934. 4 at $1,000. Nos. M0354, M0510, M2894, M2943; 2 at $500. Nos. D4647, D5337	4,752.50	
9 Southern Bell Telephone & Telegraph Co., 30-year first mortgage, 5's, sinking fund, gold, due Jan. 1, 1941. 9 at $1,000, Nos. M9739, M11576, M11577, M11578, M11579, M13965, M15568, M15569, M15570	8,942.50	
3 Union Electric Light & Power Co. of St. Louis, 5 per cent first mortgage, 30-year, gold, due New York, Sept. 1, 1932. 3 at $1,000. Nos. 1352, 4169, 8601	2,862.50	
5 Vicksburg, Shreveport & Pacific R. R. Co., prior lien mortgage, at 6 per cent gold, renewed at 5 per cent due Nov. 1, 1915; extended to Nov. 1, 1940. 5 at $1,000. Nos. 561, 661, 794, 982, 1323	5,050.00	
8 Virginian Ry. Co., first mortgage, 50-year gold 5 per cent due New York, Nov. 1, 1962. 8 at $1,000. Nos. M4290, M4291, M14151, M23372, M23821, M23822, M23823, M23824	7,891.25	
		$177,761.00
3. Bank balance, Dec. 31, 1918		14,187.34
		271,948.34

LIABILITIES.

	Income.	Capital.
General fund:		
Invested	$4,176.25	
Uninvested	508.81	
Agassiz fund:		
Invested		$50,000.00
Uninvested		
Bache fund:		
Invested	500.00	59,000.00
Uninvested	2,223.98	
Billings fund:		
Invested	50.00	8,750.00
Uninvested	97.66	1,250.00
Building fund:		
Invested	200.00	9,400.00
Uninvested	199.63	
Comstock fund:		
Invested		12,368.75
Uninvested	646.04	37.27
Consolidated fund:		
Invested		
Uninvested	1,575.33	

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	Income.	Capital.
Draper fund:		
Invested	$1,952.50	$10,000.00
Uninvested	449.30	----------
Elliot fund:		
Invested	300.00	8,000.00
Uninvested	182.57	----------
Gibbs fund:		
Invested	500.00	5,545.50
Uninvested	44.38	----------
Gould fund:		
Invested	5,255.00	19,992.50
Uninvested	1,315.96	7.50
Hale lectureship:		
Invested	200.00	----------
Uninvested	23.34	----------
Hartley fund:		
Invested	----------	1,200.00
Uninvested	76.77	----------
Marsh fund:		
Invested	150.00	19,000.00
Uninvested	857.00	----------
Murray fund:		
Invested	400.00	6,000.00
Uninvested	432.05	----------
National Research Council:		
Invested	1,865.00	----------
Uninvested	1,059.84	----------
Proceedings:		
Invested	----------	----------
Uninvested	1,247.35	----------
Smith fund:		
Invested	2,032.50	10,000.00
Uninvested	683.95	----------
Watson fund:		
Invested	1,103.75	24,996.25
Uninvested	1,087.91	3.75
	31,396.82	240,551.52
		31,396.82
		271,948.34
Consolidated investment fund:		
Invested	----------	181,718.50
Uninvested	1,575.33	177.00

CONDENSED STATEMENT OF RECEIPTS AND EXPENDITURES, 1918.

RECEIPTS.

Balance, Jan. 1, 1918, as per last report		$16,865.30
Cash receipts:		
Total income from investments	[1] $12,209.24	
Bonds called in and paid	7,250.00	
Mortgage notes paid	5,040.00	

[1] Interest to the amount of $750 (1917) and $750 (1918); total, $1,500 due from an unsettled estate.

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Cash receipts—Continued.		
Annual dues	$810.00	
Interest on bank deposits	243.76	
Wm. Ellery Hale lectureship	300.00	
Billings fund from Draper estate	2,500.00	
Contributions to Proceedings	575.00	
Subscriptions to Proceedings	1,430.74	
Reprints and separate numbers of Proceedings	344.42	
Contribution of W. W. Keen to National Research Council	483.96	
Rockefeller Foundation	10,000.00	
Return of grant to Holmes from Gibbs fund	86.32	
		$41,273.44
Book transfers:		
Income transfers	1,325.00	
Capital transfers	2,575.00	
Comstock transfer	677.50	
General fund transfer	510.00	
Distribution of income from consolidated	7,707.14	
		12,794.64
		70,933.38

EXPENDITURES.

Cash expenditures:		
Investment of capital	$21,427.50	
Accrued interest	245.62	
Dominion Coal	125.00	
		$21,798.12
Book transfers:		
Income transfers	1,325.00	
Capital transfers	2,575.00	
Comstock transfer	677.50	
General fund transfer	510.00	
Distribution of income from consolidated	7,707.14	
		12,794.64
Payments from trust and other funds:		
Bache fund—		
F. A. Shull	485.00	
J. Voûte	211.86	
Comstock fund—		
Samuel Jackson Barnett, prize and diploma	1,525.00	
Draper fund—		
Joel Stebbins	300.00	
Walter S. Adams, medal	212.80	
Elliot fund—		
F. M. Chapman, medal and honorarium	181.00 200.00	
Gould fund—		
Astronomical Journal	500.00	
Hale lectureship—		
Honorarium	300.00	
Marsh fund—		
Printing	9.75	

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Payments from trust and other funds—Continued.		
Smith fund—		
G. P. Merrill	$85.00	
S. A. Mitchell	300.00	
Watson fund—		
H. C. Wilson	300.00	
John A. Miller	500.00	
		$5,110.41
Rockefeller Foundation:		
S. A. Hanna, to Special Account	55.00	
Transfer	9,945.00	
		10,000.00
Proceedings:		
Salary, managing editor	750.00	
Printing and distributing	2,577.92	
Expenses, Boston office	265.50	
Expenses, Washington office	237.59	
		3,831.01
General fund:		
Salary, assistant secretary and treasurer	600.00	
Treasurer's office	175.00	
Home secretary's office	594.05	
Memoirs, printing, etc	1,064.61	
Meeting—		
Annual	612.60	
Autumn	137.21	
Election of members	28.38	
		3,211.86
		56,746.04
Balance Dec. 31, 1918		14,187.34
		70,933.38

ACCOUNTS WITH INDIVIDUAL FUNDS JAN. 1 TO DEC. 31, 1918.

	General fund.		Agassiz fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1918:				
Cash	$602.99			
Invested	4,686.25			$50,000.00
Receipts:				
Interest on deposits	243.76			
Interests on investments	2,359.85			
	7,892.85			50,000.00
Disbursements:				
General expenses	3,207.79			
Balance Dec. 31, 1918:				
Cash	508.81			
Invested	4,176.25			50,000.00
	7,892.85			50,000.00

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Accounts with individual funds, Jan. 1 to Dec. 31, 1918—Continued.

	Bache fund.		Billings fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1918:				
Cash	$1,249.76			
Invested	2,575.00	$56,000.00		$2,500.00
Receipts:				
Interest on investments	2,596.08		$147.66	
Transfer, income to capital		3,000.00		
From Draper estate			1,250.00	1,250.00
	6,420.84	59,000.00	1,397.66	3,750.00
Disbursements:				
Grants	685.00			
J. Voûte, expense of cable	11.86			
Transfer, income to capital	3,000.00			
Balance Dec. 31, 1918:				
Cash	2,223.98		1,347.66	
Invested	500.00	59,000.00	50.00	3,750.00
	6,420.84	59,000.00	1,397.66	3,750.00

	Building fund.		Comstock fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1918:				
Cash	$399.29		$854.25	$87.27
Invested		$9,000.00	677.50	12,318.75
Receipts:				
Interest on investments	400.33		1,316.79	
Transfer income to capital		400.00		
	799.62	9,400.00	2,848.54	12,406.02
Disbursements:				
General expenses			25.00	
Transfer income to capital	400.00			
Transfer cash from investment			677.50	
Prizes			1,500.00	
Balance Dec. 31, 1918:				
Cash	199.63		646.04	87.27
Invested	200.00	9,400.00		12,368.75
	799.62	9,400.00	2,848.54	12,406.02

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Accounts with individual funds, Jan. 1 to Dec. 31, 1918—Continued.

	Consolidated fund.		Draper fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1918:				
Cash	$1,097.53	$1,674.50	$534.89	
Invested		175,071.00	1,952.50	$10,000.00
Receipts:				
Interest on investment	8,532.09		427.21	
Cash transfer		2,575.00		
Investment transfer		2,575.00		
	9,629.62	181,895.50	2,914.60	10,000.00
Disbursements:				
Grants and medals			512.80	
Distribution of income to funds	7,707.14			
Accrued interest	347.15			
Balance Dec. 31, 1918:				
Cash	1,575.33	177.00	449.30	
Invested		181,718.50	1,952.50	10,000.00
	9,629.62	181,895.50	2,914.60	10,000.00

	Elliot fund.		Gibbs fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1918:				
Cash	$517.22		$261.33	
Invested		$8,000.00		$5,545.50
Receipts:				
Interest on investments	346.35		283.00	
	863.57	8,000.00	544.33	5,545.50
Disbursements:				
General expenses				
Medals and honorariums	381.00			
Balance Dec. 31, 1918:				
Cash	182.57		44.33	
Invested	300.00	8,000.00	500.00	5,545.50
	863.57	8,000.00	544.33	5,545.50

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Accounts with individual funds, Jan. 1 to Dec. 31, 1918—Continued.

	Gould fund.		Hale lectureship.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1918:				
Cash	$1,642.67	$57.50	$220.28	.....
Invested	4,067.50	19,942.50	.....	.....
Receipts:				
Interest on investments	1,360.79	.....	3.06	.....
Contribution to Hale lectureship	.....	.....	300.00	.....
	7,070.96	20,000.00	523.34	.....
Disbursements:				
Grants of medals	500.00	.....	.....	.....
Honorarium	.....	.....	300.00	.....
Balance Dec. 31, 1918:				
Cash	1,315.96	7.50	23.34	.....
Invested	5,255.00	19,992.50	200.00	.....
	7,070.96	20,000.00	523.34	.....

	Hartley fund.		Marsh fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1918:				
Cash	$25.51	.....	$716.81	.....
Invested	.....	$1,200.00	.....	$18,500.00
Receipts:				
Interest on investments	51.26	.....	799.94	.....
Transfer capital from income	.....	.....	.....	500.00
	76.77	1,200.00	1,516.75	19,000.00
Disbursements:				
General expenses	.....	.....	9.75	.....
Transfer income to capital	.....	.....	500.00	.....
Balance Dec. 31, 1918:				
Cash	76.77	.....	857.00	.....
Invested	.....	1,200.00	150.00	19,000.00
	76.77	1,200.00	1,516.75	19,000.00

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Accounts with individual funds, Jan. 1 to Dec. 31, 1918—Continued.

	Murray fund.		Proceedings fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1918:				
Cash	$569.61		$1,922.27	
Invested		$6,000.00		
Receipts:				
Interest on investments	262.44			
Annual dues			810.00	
Subscriptions			1,481.84	
Reprints			343.32	
Contributions			575.00	
	832.05	6 000.00	5,082.43	
Disbursements:				
Managing editor			750.00	
Boston office			269.57	
Washington office			237.59	
Printing			2,577.92	
Balance Dec. 31, 1918:				
Cash	432.05		1,247.35	
Invested	400.00	6,000.00		
	832.05	6,000.00	5,082.43	

	National Research Council		National Research Council special.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1918:				
Cash	$2,389.35			
Invested				
Receipts:				
Interest on investments	75.00		$114.25	
W. W. Keen contribution	483.96			
Rockefeller Foundation			23,856.82	
Jewell D. Emery refund			20.54	
	2,948.31		23,991.61	
Disbursements:				
Accrued interest	23.47		15,975.89	
Balance Dec. 31, 1918:				
Cash	1,059.84		8,015.72	
Invested	1,865.00			
	2,948.31		23,991.61	

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Accounts with individual funds, Jan. 1 to Dec. 31, 1918—Continued.

	Smith fund.		Watson fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1918:				
Cash	$1,064.20		$799.32	$203.75
Invested	1,532.50	$10,000.00	1,003.75	24,796.25
Receipts:				
Interest on investments	484.75		1,188.59	
	3,101.45	10,000.00	2,991.66	25,000.00
Disbursements:				
Grants awarded	385.00		900.00	
Balance Dec. 31, 1918:				
Cash	683.95		1,087.91	3.75
Invested	2,032.50	10,000.00	1,103.75	24,996.25
	3,101.45	10,000.00	2,991.66	25,000.00

WHITMAN CROSS,
Treasurer.

January 15, 1919.

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REPORT OF THE AUDITING COMMITTEE.

WASHINGTON, D. C., *January 15, 1919.*

We have employed the Capital Audit Co. to scrutinize and report on the treasurer's books. We accepted the certification, dated January 13, 1919, of the American Security & Trust Co. regarding notes on deposit owned by the academy, and we have examined the securities and papers contained in the box of the National Academy of Sciences at the vault of the American Security & Trust Co. We find them to correspond to the list checked by the auditing committee on January 14, 1918, except as modified by transactions of the year 1918 reported by the Capital Audit Co. We find that the coupons due in 1918 have been cut and are accounted for, and those due January 1, 1919, are detached and are accounted for by appropriate entries in the pass books. We find that interest on loans has been accounted for, except the interest on the Upshur note, which has been retained by litigation. Correspondence between vouchers, pass books, and accounts of the treasurer is certified by the Capital Audit Co. We find the balance reported by the treasurer as of December 31, 1918, to accord with the statement of the American Security & Trust Co. and with the check book, except for certain outstanding checks to the amount of $328.27 listed by the Capital Audit Co.

In addition to the regular financial statement of the treasurer, there is a special account in support of the division of medicine of the National Research Council. This account has been included in the report of the Capital Audit Co. We find that the treasurer's balance as of December 31, 1918, agrees with the statement of the American Security & Trust Co. for this special account.

C. G. ABBOT.
L. O. HOWARD.
DAVID WHITE.

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APPENDIXES.

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APPENDIX A.

CONSTITUTION OF THE NATIONAL ACADEMY.

As amended and adopted April 17, 1872, and further amended April 20, 1875; April 21, 1881; April 19. 1882; April 18, 1883; April 19, 1888; April 18, 1895; April 20, 1899; April 17, 1902; April 18, 1906; November 20, 1906; April 17, 1907; November 20, 1907; April 20, 1911; April 16, 1912; April 21, 1915.

PREAMBLE.

Empowered by the act of incorporation enacted by Congress, and approved by the President of the United States on the 3d day of March, A. D. 1863, and in conformity with amendments to said act approved July 14, 1870, June 20, 1884, and May 27, 1914, the National Academy of Sciences adopts the following amended constitution and rules:

ARTICLE I.—OF MEMBERS.

SECTION 1. The academy shall consist of members, honorary members, and foreign associates. Members must be citizens of the United States.

SEC. 2. Members who, from age or inability to attend the meetings of the academy, wish to resign the duties of active membership, may, at their own request, be transferred to the roll of honorary members by a vote of the academy.

SEC. 3. The academy may elect 50 foreign associates.

SEC. 4. Honorary members and foreign associates shall have the privilege of attending the meetings and of reading and communicating papers to the academy, but shall take no part in its business, shall not be subject to its assessments, and shall be entitled to a copy of the publications of the academy.

ARTICLE II.—OF THE OFFICERS.

SECTION 1. The officers of the academy shall be a president, a vice president, a foreign secretary, a home secretary, and a treasurer, all of whom shall be elected for a term of four years, by a majority of votes present, at the first stated meeting after the expiration of the current terms, provided that existing officers retain their places until their successors are elected. In case of a vacancy, the election for

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four years shall be held in the same manner at the meeting when such vacancy occurs, or at the next stated meeting thereafter, as the academy may direct. A vacancy in the office of treasurer or home secretary may, however, be filled by appointment of the president of the academy until the next stated meeting of the academy.

SEC. 2. The officers of the academy, together with six members to be elected by the academy, shall constitute a council for the transaction of such business as may be assigned to them by the constitution or the academy.

SEC. 3. The president of the academy, or, in case of his absence or inability to act, the vice president, shall preside at the meetings of the academy and of the council; shall name all committees except such as are otherwise especially provided for; shall refer investigations required by the Government of the United States to members especially conversant with the subjects and report thereon to the academy at its meeting next ensuing; and, with the council, shall direct the general business of the academy.

It shall be competent for the president, in special cases, to call in the aid, upon committees, of experts or men of special attainments not members of the academy.

The president shall be, ex officio, a member of all committees empowered to consider questions referred to the academy by the Government of the United States.

SEC. 4. The foreign and home secretaries shall conduct the correspondence proper to their respective departments, advising with the president and council in cases of doubt, and reporting their action to the academy at one of the stated meetings in each year.

It shall be the duty of the home secretary to give notice to the members of the place and time of all meetings, of all nominations for membership, and of all proposed amendments to the constitution.

It shall be the duty of the home secretary to keep the minutes of each business and scientific session, and after approval to enter these upon the permanent records of the academy.

SEC. 5. The treasurer shall attend to all receipts and disbursements of the academy, giving such bond and furnishing such vouchers as the council may require. He shall collect all dues, assessments, and subscriptions, and keep a set of books showing a full account of receipts and disbursements and the condition of all funds of the academy. He shall be the custodian of the corporate seal of the academy.

ARTICLE III.—OF THE MEETINGS.

SECTION 1. That the academy shall hold one stated meeting, called the annual meeting, in April of each year in the city of Washington, and another stated meeting, called the autumn meeting, at a place

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to be determined by the council. The council shall also have power to fix the date of each meeting.

Special business meetings of the academy may be called, by order of eight members of the council, at such place and time as may be designated in the call.

Special scientific meetings of the academy may be held at times and places to be designated by a majority of the council.

SEC. 2. The names of the members present at each session of a meeting shall be recorded in the minutes, and the members present at any session shall constitute a quorum for the transaction of business.

SEC. 3. Scientific sessions of the academy, unless otherwise ordered by a majority of the members present, shall be open to the public; sessions for the transaction of business shall be closed.

SEC. 4. Stated meetings of the council shall be held during the stated or special meetings of the academy and four members shall constitute a quorum for the transaction of business. Special meetings of the council may be convened at the call of the president and two members of the council, or of four members of the council.

SEC. 5. No member whose dues are in arrears shall vote at any business meeting of the academy.

ARTICLE IV.—OF ELECTIONS AND RESIGNATIONS.

SECTION 1. All elections of officers and members shall be by ballot, and each election shall be held separately.

SEC. 2. The time for holding an election of officers shall be fixed by the academy at least one day before the election is held.

SEC. 3. The election of the six members of the council shall be as follows:

At the annual meeting in April, 1907, six members of the council to be elected, of whom two shall serve for three years, two for two years, and two for one year, their respective terms to be determined by lot. Each year thereafter the terms of two members shall expire, and their successors, to serve for three years, shall be elected at the annual meeting in each year.

SEC. 4. The academy shall be divided by the council into sections representing the principal branches of scientific research. Each section shall elect its own chairman, who shall serve for three years. The chairman shall be responsible to the academy for the work of his section.

Nominations to membership in the academy shall be made in writing and approved by a majority of the members of the section on the branch of research in which the person nominated is eminent, or by a majority of the council in case there is no section on the subject.

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The nomination shall be sent to the home secretary by the chairman of the section before January 1 of the year in which the election is to be held, and each nomination shall be accompanied by a list of the principal contributions of the nominee to science. This list shall be printed by the home secretary for distribution among the members of the academy.

SEC. 5. Election of members shall be held at the annual meeting in Washington in the following manner: There shall be two ballots—a preference ballot, which may be prepared either before or at the annual meeting, and must be transmitted to the home secretary, and a final ballot, to be taken at the meeting.

Preference ballot.—Each member may inscribe on a ballot not more than 15 names of nominees selected from the submitted list. A list of the nominees shall then be prepared, on which the names shall be entered in the order of the number of votes received by each. In case two or more nominees have the same number of votes on this preference list, the order in which they shall be placed on the list shall be determined by a majority vote of members present.

Final ballot.—A vote shall first be taken on the nominee who appears first on the preference list, and he shall be declared elected if he receive two-thirds of the votes cast and not less than 25 votes in all. A vote shall then be taken in similar manner on the nominee standing second on the preference list, and so on until all the nominees on the preference list shall have been acted on, or until 15 nominees shall have been elected, or until the total membership of the academy shall have reached 250.

Not more than 15 members shall be elected at one annual meeting.

Before and during elections a discussion of the merits of nominees will be in order.

SEC. 6. Every member-elect shall accept his membership, personally or in writing, before the close of the next stated meeting after the date of his election. Otherwise, on proof that the secretary has formally notified him of his election, his name shall not be entered on the roll of members.

SEC. 7. Foreign associates may be nominated by the council and may be elected at the annual meeting by a two-thirds vote of the members present.

SEC. 8. A diploma, with the corporate seal of the academy and the signatures of the officers, shall be sent by the appropriate secretary to each member on his acceptance of membership, and to foreign associates on their election.

SEC. 9. Resignations shall be addressed to the president and acted on by the academy.

SEC. 10. Whenever a member has not paid his dues for four successive years, the treasurer shall report the fact to the council, which

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may report the case to the academy with the recommendation that the person thus in arrears be declared to have forfeited his membership. If this recommendation be approved by two-thirds of the members present, the said person shall no longer be a member of the academy and his name shall be dropped from the roll.

ARTICLE V.—SCIENTIFIC COMMUNICATIONS, PUBLICATIONS, AND REPORTS.

SECTION 1. Communications on scientific subjects shall be read at scientific sessions of the academy, and papers by any member may be read by the author or by any other member, notice of the same having been previously given to the secretary.

SEC. 2. Any member of the academy may read a paper from a person who is not a member, and shall not be considered responsible for the facts or opinions expressed by the author, but shall be held responsible for the propriety of the paper.

Persons who are not members may read papers on invitation of the council or of the committee of arrangements.

SEC. 3. The academy may provide for the publication, under the direction of the council, of proceedings, scientific memoirs, biographical memoirs, and reports.

The proceedings shall include the transactions of the academy, brief original announcements of the results of scientific investigations made by members of the academy or others, together with short original articles giving a comprehensive survey of the more important scientific researches currently made by American investigators, and other matters of general scientific interest.

The scientific memoirs shall provide opportunity for the publication of longer and more detailed scientific investigations.

The biographical memoirs shall contain an appropriate record of the life and work of deceased members of the academy.

An annual report shall be presented to Congress by the president and shall contain the annual reports of the treasurer and the auditing committee, a suitable summary of the reports of the committees in charge of trust funds, and a record of the activities of the academy for the calendar year immediately preceding, and other appropriate matter. This report shall be presented to Congress by the president after authorization by the council. It shall also be presented to the academy at the annual meeting next following.

The treasurer shall prepare a full report of the financial affairs of the academy at the end of the fiscal year. This report shall be submitted to the council for approval and afterwards presented to the academy at the annual meeting.

SEC. 4. Propositions for investigations or reports by the academy shall be submitted to the council for approval, except those requested

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by the Government of the United States, which shall be acted on by the president, who will in such cases report their results to the Government as soon as obtained and to the academy at its next following stated meeting.

SEC. 5. The advice of the academy shall be at all times at the disposition of the Government upon any matter of science or art within its scope.

ARTICLE VI.—OF THE PROPERTY OF THE ACADEMY.

SECTION 1. All investments and reinvestments of either principal or accumulations of income of the trust and other funds of the academy shall be made by the treasurer, with the approval of the finance committee, in the corporate name of the academy, in the manner and in the securities designated or specified in the instruments creating the several funds, or, in the absence of such designation or specification, in bonds of the United States or of the several States, or in bonds or notes secured by first mortgages on real estate, in investments legal for savings banks under the laws of Massachusetts or New York, or in other bonds recommended to the treasurer by the fiscal advisers of the academy.

The treasurer may invest the capital of all trust funds of the academy which are not required by the instruments creating such funds to be kept separate and distinct, in a consolidated fund, and shall apportion the income received from such consolidated fund among the various funds composing the same in the proportion that each of said funds shall bear to the total amount of funds so invested; provided, however, that the treasurer shall at all times keep accurate accounts showing the amount of each trust fund, the proportion of the income from the consolidated fund to which it is entitled, and the expenses and disbursements properly chargeable to such fund.

SEC. 2. The council shall at its annual meeting in each year designate one bank or trust company in Washington, D. C., and one in New York City to act, when requested by the treasurer, as the fiscal advisers of the academy.

SEC. 3. The treasurer shall have authority, with the approval of the finance committee, to sell, transfer, convey, and deliver in the corporate name and for the benefit of the academy any stocks, bonds, or other securities standing in the corporate name.

SEC. 4. No contract shall be binding upon the academy which has not been first approved by the council.

SEC. 5. The assessments required for the support of the academy shall be fixed by the academy on the recommendation of the council and shall be payable within the calendar year for which they are assessed.

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ARTICLE VII.—OF TRUST FUNDS AND THEIR ADMINISTRATION.

SECTION 1. Devises, bequests, donations, or gifts having for their object the promotion of science or the welfare of the academy may be accepted by the council for the academy. Before the acceptance of any such trust the council shall consider the object of the trust and all conditions or specifications attaching thereto. The council shall make a report of its action to the academy.

SEC. 2. Medals and prizes may be established in accordance with the provisions of trusts or by action of the academy.

SEC. 3. Unless otherwise provided by the deed of gift, the income of each trust fund shall be applied to the objects of that trust by the action of the academy on the recommendation of a standing committee on that fund.

ARTICLE VIII.—OF ADDITIONS AND AMENDMENTS.

Additions and amendments to the constitution shall be made only at a stated meeting of the academy. Notice of a proposition for such a change must be submitted to the council, which may amend the proposition, and shall report thereon to the academy. Its report shall be considered by the academy in committee of the whole for amendment.

The proposition as amended, if adopted in committee of the whole, shall be voted on at the next stated meeting, and if it receives two-thirds of the votes cast it shall be declared adopted.

Absent members may send their votes on pending changes in the constitution to the home secretary in writing, and such votes shall be counted as if the members were present.

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APPENDIX B.

RULES.

(In accordance with a resolution of the academy, taken at its meeting on April 21, 1915, the rules are arranged in groups and each group is numbered to correspond with the article of the constitution to which it relates.)

I.

1. The holders of the medal for eminence in the application of science to the public welfare shall be notified, like members, of the meetings of the academy, and invited to participate in its scientific sessions.

II.

1. The proper secretary shall acknowledge all donations made to the academy, and shall at once report them to the council for its consideration.

2. The home secretary shall be the custodian of all books, apparatus, archives, and collections not explicitly assigned to other care.

3. The home secretary shall keep a record of all grants of money or awards of prizes or medals made from trust funds of the academy. The record for each grant of money shall include the following items:

1. Name of fund.
2. Date and number of the grant.
3. Name and address of recipient.
4. Amount of grant and date or dates of payment.
5. Purpose of grant.
6. Record of report of progress.
7. Resulting publications.

4. The treasurer shall keep the home secretary informed of all warrants received from directors of trust funds not controlled by the academy and of the date or dates of payment of all warrants.

5. The treasurer is authorized to defray, when approved by the president, all the proper expenses of committees appointed to make scientific investigations at the request of departments of the Government, and in each case to look to the department requesting the investigation for reimbursement to the academy.

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III.

1. The annual meeting of the academy shall begin on the fourth Monday of April. At the business sessions of the academy the order of procedure shall be as follows:

1. Chair taken by the president, or, in his absence, by the vice president.
2. Roll of members called by home secretary (first session of the meeting only).
3. Minutes of the preceding session read and approved.
4. Stated business.
5. Reports of president, secretaries, treasurer, and committees.
6. Business from council.
7. Other business.

2. The rules of order of the academy shall be those of the Senate of the United States, unless otherwise provided by the constitution or rules of the academy.

3. In the absence of any officer a member shall be chosen to perform his duties temporarily, by a plurality of *viva voce* votes, upon open nomination.

4. At each meeting the president shall announce the death of any members since the preceding meeting. As soon as practicable thereafter he shall designate a member to write—or to secure from some other source approved by the president—a biographical notice of each deceased member.

5. A standing committee of three members called the program committee, a local committee of five members appointed for each meeting, and the home secretary shall together constitute the committee of arrangements, of which the home secretary shall be chairman.

The term of service on the program committee shall be three years, one member retiring annually, the chairman to be designated by the president.

It shall be the duty of the program committee to prepare the scientific program for the annual meeting, and for this purpose it shall be empowered to solicit papers from members or others. It shall also be empowered to ascertain the length of time required for reading papers to be presented at the scientific sessions of the academy, and, when it appears advisable to limit the time to be occupied in their presentation or discussion.

The local committee shall meet not less than two months previous to each meeting. It shall prepare the detailed program of each day, and in general shall have charge of all business and scientific ar-

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rangements for the meeting for which it is appointed except those specifically assigned to the program committee in the case of the annual meeting.

IV.

1. The term of service of each chairman of a section shall be three years, to date from the closing session of the April meeting next following his election. Chairmen of sections shall be chosen by mail ballot, the member receiving the highest number of votes cast to be deemed elected. It shall be the duty of each retiring chairman to conduct the election of his successor and to report the result of the election to the home secretary before the April meeting at which his term of service expires. Should any section fail to elect a chairman before November 1, the president is empowered to appoint a temporary chairman to serve until the April meeting next following. No chairman shall be eligible for reelection for two consecutive terms.

2. The chairman of each section of the academy shall submit to the members of his section, not later than November 1 of each year, a ballot containing the names of all those persons who received not less than two votes in the nominating ballot of the preceding year and of any other persons who were newly proposed for consideration at that time. Each member of the section shall be expected to return this ballot to the chairman within two weeks with his signature and with crosses placed against the names of those persons whom he is prepared to indorse for nomination. Each member may also write upon the ballot in a place provided for the purpose any new names which he desires to have included in the ballot to be submitted to the section in the following year. The vote resulting from this ballot shall be regarded as informal.

The chairman shall then submit to the members of his section a new ballot showing the results of the informal vote; and each member shall be expected to return this ballot to the chairman with his signature and with crosses placed against the names of those persons whom he will indorse for nomination. In order to secure an adequate number of nominations, the chairman, when necessary, shall obtain by personal solicitation a fuller vote of his section or shall submit to the section a supplementary formal ballot.

The chairman shall then certify to the home secretary, prior to January 1, the names of those persons who have been voted for on the formal ballots by a majority of the members of the section, and shall furnish him a list of the publications of these nominees, as required by the constitution.

3. Nominations for membership shall give the full name, residence, and the official positions successively held by the candidate, in addi-

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tion to the list of his contributions to science required by the constitution.

4. Preference ballots for election of members shall be sealed in a blank envelope, which shall be inclosed in another bearing the name of the sender, and which shall be addressed to the home secretary. Such envelopes shall be opened only by the tellers. If in any case the tellers are unable to determine who cast a ballot, or if the latter contains more names than are to be voted for, the ballot shall be rejected, but minor defects in a ballot shall be disregarded when the intent of the voter is obvious.

5. All discussions of the claims and qualifications of nominees at meetings of the academy shall be held strictly confidential, and remarks and criticisms then made may be communicated to no person who was not a member of the academy at the time of the discussion.

V.

1. The publication of the proceedings shall be under the general charge of the council, which shall have final jurisdiction upon all questions of policy relating thereto. The preparation of the proceedings for publication shall be intrusted to an editorial board. This board shall consist of a chairman and a managing editor, both of whom shall be appointed by the council for definite terms of service; of the home secretary and foreign secretary *ex officiis*, and of a body of associate editors representing the various branches of science which are to be included in the scope of the proceedings. The managing editor, who may be a nonmember of the academy, shall receive a salary, which shall be fixed by the council. It shall be the duty of the managing editor to prepare the proceedings in detail for publication; but the chairman of the editorial board shall decide, in consultation with the managing editor, in regard to the acceptance, rejection, or substantial modification of papers offered for publication. The associate editors shall be appointed by the council, upon recommendation of the chairman of the editorial board, for a period of three years, one-third of them retiring annually. The home secretary and the foreign secretary shall be responsible for the distribution of the proceedings in their respective fields.

2. Memoirs may be presented at any time to the home secretary, who shall report the date of their reception at the next session; but no memoir shall be published unless it has been read or presented by title before the academy.

Before publication all biographical and scientific memoirs must be referred to the committee on publication, who may, if they deem best, refer any memoir to a special committee appointed by the president to determine whether the same should be published by the academy.

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3. Memoirs shall date, in the records of the academy, from the date of their presentation to the academy, and the order of their presentation shall be so arranged by the secretary that, so far as may be convenient, those upon kindred topics shall follow one another.

4. The annual report of the treasurer shall contain:

1. A concise statement of the source, object, and amount of all trust funds of the academy.
2. A condensed statement of receipts and expenditures.
3. A statement of assets and liabilities.
4. Accounts with individual funds.
5. Such other matter as he considers appropriate.

5. The accounts of the treasurer shall, between January 1 and January 15 of each year, be audited by a committee of three members to be appointed by the president at the autumn meeting of the academy. It shall be the duty of the auditing committee to verify the record of receipts and disbursements maintained by the treasurer and the agreement of book and bank balances; to examine all securities in the custody of the treasurer and to compare the stated income of such securities with the receipts of record; to examine all vouchers covering disbursements for account of the academy and the authority therefor and to compare them with the treasurer's record of expenditures; to examine and verify the account of the academy with each trust fund. The auditing committee may employ an expert accountant to assist the committee in the examination of the books of the treasurer. The annual report of the treasurer shall be published with that of the president to Congress. The reports of the treasurer and auditing committee shall be presented to the academy at the annual meeting.

VI.

1. All apparatus and other materials of permanent value purchased with money from any grant from a trust fund shall be the property of the academy unless specific exception is made in the grant or by subsequent action of the council or the directors of the trust fund concerned. Receipts for all such property shall be signed by the grantee and shall be forwarded to the home secretary. All apparatus and unused material of value acquired in this way shall be delivered to the home secretary on completion of the investigation for which the grant was made, or at any time on demand of the council, and the home secretary shall give an appropriate release therefor.

2. The books, apparatus, archives, and other collections of the academy shall be deposited in some safe place in the city of Washington. A list of the articles so deposited shall be kept by the home secretary, who is authorized to employ a clerk to take charge of them.

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3. A stamp corresponding to the corporate seal of the academy shall be kept by the secretaries, who shall be responsible for the due markings of all books and other objects to which it is applicable.

Labels or other proper marks of similar device shall be placed upon objects not admitting of the stamp.

4. The fiscal year of the academy shall end on December 31 of each year.

5. The standing committee on finance shall consist of the treasurer ex officio as chairman and two members to be appointed annually by the president.

VII.

1. Standing committees of the academy on trust funds the income of which is applied to the promotion of research shall consist of three or five members. In order to secure rotation in office in such committees, when not in conflict with the provisions of the deeds of gift, the term of service on a committee of three members shall be three years; on a committee of five members the term shall be five years.

2. The annual reports of the committees on research funds shall, so far as the academy has authority to determine their form, give a current number to each award, stating the name, position, and address of the recipient; the subject of research for which the award is made, and the sum awarded; and in later annual reports the status of the work accomplished under each award previously made shall be announced, until the research is completed, when announcement of its completion and, if published, the title and place of publication shall be stated, and the record of the award shall be reported as closed.

VIII.

1. Any rule of the academy may be amended, suspended, or repealed on the written motion of any two members, signed by them, and presented at a stated meeting of the academy, provided the same shall be approved by a majority of the members present.

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APPENDIX C.

ORGANIZATION OF THE ACADEMY, 1918–19.

	Expiration of term.
WALCOTT, CHARLES D., *President*	April, 1923
MICHELSON, A. A., *Vice President*	April, 1923
HALE, GEORGE E., *Foreign Secretary*	April, 1922
ABBOT, C. G., *Acting Home Secretary*	April, 1919
CROSS, WHITMAN, *Treasurer*	April, 1923

ADDITIONAL MEMBERS OF COUNCIL.

1916–1919.

CHITTENDEN, R. H. — PUPIN, M. I.

1917–1920.

CONKLIN, E. G. — NOYES, A. A.

1918–1921.

ABBOT, C. G. — HOWELL, W. H.

SECTIONS.

1. MATHEMATICS.

BIRKHOFF, G. D.
BLISS, G. A.
BOLZA, OSKAR
DICKSON, L. E.
KASNER, EDWARD
MOORE, E. H.
OSGOOD, W. F.
STORY, W. E.
VAN VLECK, E. B. (*Chairman, 1916–1919*)
WHITE, H. S.

2. ASTRONOMY.

ABBOT, C. G.
ADAMS, W. S.
AITKEN, R. G.
BARNARD, E. E.
CAMPBELL, W. W. (*Chairman, 1917–1920*)
COMSTOCK, G. C.
ELKIN, W. L.
FROST, E. B.
LEUSCHNER, A. O.
HALE, G. E.
MOULTON, F. R.
RUSSELL, H. N.
SCHLESINGER, FRANK

3. PHYSICS.

ABBOT, H. L.
AMES, J. S.
BABUS, CARL
BELL, A. G.
BRIDGMAN, P. W.
BUMSTEAD, H. A.
CARTY, J. J.
CREW, HENRY
DURAND, W. F.
FREEMAN, J. R.
HALL, E. H.
HASTINGS, C. S.
HAYFORD, J. F.
JEWETT, F. B.
LYMAN, THEODORE
MENDELHALL, C. E.
MENDENHALL, T. C.
MERRITT, ERNEST
MICHELSON, A. A.
MILLIKAN, R. A.
NICHOLS, E. F. (*Chairman, 1917–1920*)
NICHOLS, E. L.
PUPIN, M. I.
ROSA, E. B.
SABINE, W. C.
STRATTON, S. W.
TAYLOR, D. W.
THOMSON, ELIHU
TROWBRIDGE, JOHN
WEBSTER, A. G.
WOOD, R. W.
WOODWARD, R. S.

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4. CHEMISTRY.

BAXTER, G. P.
BOGERT, M. T.
BOLTWOOD, B. B.
CHANDLER, C. F.
CLARKE, F. W.
FRANKLIN, E. C.
GOMBERG, MOSES
GOOCH, F. A.
HILLEBRAND, W. F.
HOWE, H. M.
JACKSON, C. L.
LANGMUIR, IRVING
LEWIS, G. N.
MICHAEL, ARTHUR
MORLEY, E. W.
MORSE, H. N.
NOYES, A. A.
NOYES, W. A.
OSBORNE, T. B.
REMSEN, IRA
RICHARDS, T. W. (*Chairman, 1916–1919*)
SMITH, ALEXANDER
SMITH, EDGAR F.
STIEGLITZ, JULIUS
WELLS, H. L.
WHITNEY, W. R.

5. GEOLOGY AND PALEONTOLOGY.

BECKER, G. F.
BRANNER, J. C.
CHAMBERLIN, T. C.
CLARKE, J. M. (*Chairman, 1918–1921*)
CROSS, WHITMAN
DALL, W. H.
DANA, E. S.
DAVIS, W. M.
DAY, A. L.
IDDINGS, J. P.
KEMP, J. F.
LINDGREN, WALDEMAR
MERRIAM, J. C.
OSBORN, H. F.
PIRSSON, L. V.
PUMPELLY, RAPHAEL
RANSOME, F. L.
REID, H. F.
SCHUCHERT, CHARLES
SCOTT, W. B.
ULRICH, E. O.
WALCOTT, C. D.
WHITE, DAVID

6. BOTANY.

BAILEY, L. H.
BRITTON, N. L.
CAMPBELL, D. H.
COULTER, J. M.
FARLOW, W. G.
GOODALE, G. L.
HARPER, R. A.
SARGENT, C. S.
SMITH, ERWIN F. (*Chairman, 1918–1921*)
THAXTER, ROLAND
TRELEASE, WILLIAM

7. ZOOLOGY AND ANIMAL MORPHOLOGY.

ALLEN, J. A.
CASTLE, W. E.
CONKLIN, E. G.
DAVENPORT, C. B.
DONALDSON, H. H.
FORBES, S. A.
HARRISON, R. G.
HERRICK, C. J.
HOWARD, L. O.
JENNINGS, H. S.
LILLIE, F. R.
MARK, E. L.
MAYOR, A. G.
MERRIAM, C. H.
MORGAN, T. H.
MORSE, E. S.
PARKER, G. H. (*Chairman, 1916–1919*)
PEARL, RAYMOND
RIDGWAY, ROBERT
VERRILL, A. E.
WHEELER, W. M.
WILSON, EDMUND B.

8. PHYSIOLOGY AND PATHOLOGY.

ABEL, J. J.
BENEDICT, F. G.
CANNON, W. B.
CHITTENDEN, R. H.
COUNCILMAN, W. T.
CUSHING, HARVEY
FLEXNER, SIMON
FOLIN, OTTO
HALSTED, W. S.
HEKTOEN, LUDVIG
HOWELL, W. H. (*Chairman, 1916–1919*)
JONES, WALTER
LEVENE, P. A. T.
LOEB, JACQUES
LUSK, GRAHAM
MELTZER, S. J.
MENDEL, L. B.
PRUDDEN, T. M.
SMITH, THEOBALD
VAUGHAN, V. C.
WELCH, W. H.
WOOD, H. C.

9. ANTHROPOLOGY AND PSYCHOLOGY.

BOAS, FRANZ.
CATTELL, J. McK.
DEWEY, JOHN.
FEWKES, J. W. (*Acting Chairman*).
HALL, G. S.
HOLMES, W. H.
THORNDIKE, E. L.

STANDING COMMITTEES.

ON WEIGHTS, MEASURES, AND COINAGE.

MENDENHALL, T. C. (*Chairman*). MICHELSON, A. A. MORLEY, E. W.
WEBSTER, A. G. WOODWARD, R. S.

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ON SOLAR RESEARCH.

HALE, G. E. (*Chairman*). CAMPBELL, W. W. MICHELSON, A. A.
NICHOLS, E. L. PICKERING, E. C.

ON PUBLICATION.

The PRESIDENT. The HOME SECRETARY. ROSA, E. B.

EDITORIAL BOARD OF THE PROCEEDINGS.

PEARL, RAYMOND (*Chairman*). WILSON, EDWIN B. (*Managing Editor*).
ABBOT, C. G. (*Acting Home Secretary*). HALE, G. E. (*Foreign Secretary*).
CLARKE, J. M., 1921. JENNINGS, H. S., 1921. MOORE, E. H., 1920.
DONALDSON, H. H., 1919. LOEB, JACQUES, 1920. NOYES, A. A., 1919.
FROST, E. B., 1920. LUSK, GRAHAM, 1919. NOYES, W. A., 1921.
HARPER, R. A., 1919. MAYOR, A. G., 1919. THORNDIKE, E. L., 1920.
HEKTOEN, LUDVIG, 1921. MILLIKAN, R. A., 1921. WHEELER, W. M., 1920.

ON COLLECTION OF HISTORICAL PORTRAITS, MANUSCRIPTS, INSTRUMENTS, ETC.

WALCOTT, C. D. (*Chairman*). CLARKE, F. W. HALE, G. E.
MELTZER, S. J. PUPIN, M. I.

ON PROGRAM.

J. C. MERRIAM (*Chairman*), 1921. PEARL, RAYMOND, 1920.
THORNDIKE, E. L., 1919.

FINANCE COMMITTEE.

CROSS, WHITMAN (*Chairman*). HOWARD, L. O. WALCOTT, C. D.

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Researches in physical and natural science.

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Watson medal and the promotion of astronomical research.

LEUSCHNER, A. O. (*Chairman*). COMSTOCK, G. C. ELKIN, W. L.

THE HENRY DRAPER FUND.

[$10,000.]

Draper medal and investigations in astronomical physics.

CAMPBELL, W. W. (*Chairman*), 1919. ABBOT, C. G., 1921. AMES, J. S., 1920.
HALE, G. E., 1923. MICHELSON, A. A., 1922.

THE J. LAWRENCE SMITH FUND.

[$10,000.]

J. Lawrence Smith medal and investigations of meteoric bodies.

MORLEY, E. W. (*Chairman*), 1919. DANA, E. S., 1923. CROSS, WHITMAN, 1922.
PICKERING, E. C., 1920. WOOD, R. W., 1921.

THE BARNARD MEDAL.[1]

Meritorious service to science.

NOYES, A. A. (*Chairman*). CAMPBELL, W. W. NICHOLS, E. F.
MORGAN, T. H. RICHARDS, T. W.

[1] Every five years the committee recommends the person whom they consider most deserving of the medal, and upon the approval of the academy the name of the nominee is forwarded to the trustees of Columbia University, who administer the Barnard Medal Fund.

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THE BENJAMIN APTHORP GOULD FUND.

[$20,000.]

Researches in astronomy.

MOULTON, F. R. (*Chairman*). BARNARD, E. E. WOODWARD, R. S.

THE WOLCOTT GIBBS FUND.

[$5,545.50.]

Chemical research.

JACKSON, C. L. (*Chairman*). RICHARDS, T. W. SMITH, EDGAR F.

THE COMSTOCK FUND.

[$12,406.02.]

Researches in electricity, magnetism, and radiant energy.

NICHOLS, E. L. (*Chairman*), 1923. MILLIKAN, R. A., 1921. NOYES, A. A., 1919.
THOMPSON, ELIHU, 1920. WEBSTER, A. G., 1922.

THE MARSH FUND.

[$19,000.]

Original research in the natural sciences.

MOORE, E. H. (*Chairman*), 1919. DANA, E. S., 1920.

SCHUCHERT, CHARLES, 1921.

THE AGASSIZ FUND.

[$50,000.]

General uses of the academy.

THE MURRAY FUND.

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Agassiz medal and contributions to oceanography.

DALL, W. H. (*Chairman*), 1921. DAVIS, W. M., 1919. PARKER, G. H., 1920.

THE MARCELLUS HARTLEY FUND.

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Medal for Eminence in the Application of Science to the Public Welfare.

BECKER, G. F. (*Chairman*), 1919. HILLEBRAND, W. F., 1919.
OSBORN, H. F., 1921. PUPIN, M. I., 1921. SMITH, THEOBALD, 1920.
WEBSTER, A. G., 1920.

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To assist meritorious investigators, especially in the direction of original research.

The sum of $40,000 was contributed by Fairman Rogers, Joseph Patterson, George W. Childs, and others, as an expression of their respect and esteem for Prof. Joseph Henry. This amount was deposited with the Pennsylvania Co. for the Insurance of Lives and Granting Annuities in Trust, with authorization to collect the income thereon and to pay over the same to Prof. Joseph Henry during his natural life, and after his death to his wife and daughters, and after the death of the last survivor to "deliver the said fund and the securities in which it shall then be invested to the National Academy of Sciences, to be thenceforward forever held in trust under the name and title of the 'Joseph Henry fund.'"

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MEMBERS OF THE NATIONAL ACADEMY OF SCIENCES.

DECEMBER 31, 1918.

	Date of election.
ABBOT, CHARLES GREELEY—*Smithsonian Institution, Washington, D. C.*	1915
ABBOT, HENRY L., U. S. A—*23 Berkeley St., Cambridge, Mass.*	1872
ABEL, JOHN JACOB—*Johns Hopkins University, Baltimore, Md.*	1912
ADAMS, WALTER SYDNEY—*Solar Observatory Office, Pasadena, Cal.*	1917
AITKEN, ROBERT GRANT—*Lick Observatory, Mount Hamilton, Cal.*	1918
ALLEN, J. ASAPH—*American Museum of Natural History, N. Y. City.*	1876
AMES, JOSEPH S—*Johns Hopkins University, Baltimore, Md.*	1909
BAILEY, LIBERTY HYDE—*Ithaca, N. Y.*	1917
BARNARD, E. E—*Yerkes Observatory, Williams Bay, Wis.*	1911
BARUS, CARL—*Brown University, Providence, R. I.*	1892
BAXTER, GREGORY PAUL—*T. J. Coolidge, jr., Mem. Lab., Cambridge, Mass.*	1916
BECKER, GEORGE F—*U. S. Geological Survey, Washington, D. C.*	1901
BELL, A. GRAHAM—*1331 Connecticut Ave., Washington, D. C.*	1883
BENEDICT, FRANCIS GANO—*Nutrition Laboratory, Boston, Mass.*	1914
BIRKHOFF, GEORGE DAVID—*Harvard University, Cambridge, Mass.*	1918
BLISS, GILBERT AMES—*University of Chicago, Chicago, Ill.*	1916
BOAS, FRANZ—*Columbia University, New York City.*	1900
BOGERT, MARSTON TAYLOR—*Chemical Warfare Service, U. S. Army Unit F, 7th and B Streets NW., Washington, D. C.*	1916
BOLTWOOD, B. B—*Yale University, New Haven, Conn.*	1911
BOLZA, OSKAR—*Reichsgrafenstr. 10, Freiburg, Germany.*	1909
BRANNER, JOHN C—*Stanford University, California.*	1905
BRIDGMAN, PERCY WILLIAMS —*Jefferson Physical Laboratory, Cambridge, Mass.*	1918
BRITTON, NATHANIEL LORD—*New York Botanical Gardens, N. Y. City.*	1914
BUMSTEAD, HENRY ANDREWS—*Yale University, New Haven, Conn.*	1913
CAMPBELL, D. H—*Stanford University, California.*	1910
CAMPBELL, WILLIAM W—*Lick Observatory, Mount Hamilton, Cal.*	1902
CANNON, WALTER BRADFORD—*Harvard University, Cambridge, Mass.*	1914
CARTY, JOHN J—*Am. Telegraph and Telephone Co., N. Y. City.*	1917
CASTLE, WILLIAM ERNEST—*186 Payson Road, Belmont, Mass.*	1915
CATTELL, JAMES MCK—*Garrison, N. Y.*	1901
CHAMBERLIN, THOMAS C—*University of Chicago, Chicago, Ill.*	1903
CHANDLER, CHARLES F—*Columbia University, New York City.*	1874
CHITTENDEN, RUSSELL H—*Sheffield Scientific School, New Haven, Conn.*	1890
CLARKE, F. W—*U. S. Geological Survey, Washington, D. C.*	1909
CLARKE, J. M—*State Hall, Albany, N. Y.*	1909
COMSTOCK, GEORGE C—*Washburn Observatory, Madison, Wis.*	1899
CONKLIN, E. G—*Princeton, N. J.*	1908
COULTER, J. M—*University of Chicago, Chicago, Ill.*	1909
COUNCILMAN, WILLIAM T—*Harvey Medical School, Boston, Mass.*	1904
CREW, HENRY—*Northwestern University, Evanston, Ill.*	1909
CROSS, WHITMAN—*2138 Bancroft Place, Washington, D. C.*	1908

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		Date of election.
CUSHING, HARVEY	*Harvard University, Cambridge, Mass.*	1917
DALL, WILLIAM H	*Smithsonian Institution, Washington, D. C.*	1897
DANA, EDWARD S.	*Yale University, New Haven, Conn.*	1884
DAVENPORT, CHARLES B.	*Cold Spring Harbor, N. Y.*	1912
DAVIS, WILLIAM MORRIS	*31 Hawthorn St., Cambridge, Mass.*	1904
DAY, ARTHUR L.	*Corning Glass Works, P. O. Box 544, Corning, N. Y.*	1911
DEWEY, JOHN	*Columbia University, New York City.*	1910
DICKSON, LEONARD E.	*University of Chicago, Chicago, Ill.*	1913
DONALDSON, HENRY HERBERT	*Wistar Institute of Anatomy, Phila., Pa.*	1914
DURAND, WILLIAM FREDERICK	*Leland Stanford University, Cal.*	1917
ELKIN, WILLIAM L.	*Yale University Observatory, New Haven, Conn.*	1895
FARLOW, W. G.	*Harvard University, Cambridge, Mass.*	1879
FEWKES, JESSE WALTER	*Bureau of American Ethnology, Wash., D. C.*	1914
FLEXNER, SIMON	*Rockefeller Institute, New York City.*	1908
FOLIN, OTTO	*Harvard Medical School, Boston, Mass.*	1916
FORBES, STEPHEN ALFRED	*Urbana, Ill.*	1918
FRANKLIN, EDWARD CURTIS	*Stanford University, California.*	1914
FREEMAN, JOHN RIPLEY	*Providence, R. I.*	1918
FROST, EDWIN B.	*Yerkes Observatory, Williams Bay, Wis.*	1908
GOMBERG, MOSES	*University of Michigan, Ann Arbor, Mich.*	1914
GOOCH, FRANK A.	*291 Edwards St., New Haven, Conn.*	1897
GOODALE, GEORGE L.	*Harvard University, Cambridge, Mass.*	1890
HALE, GEORGE E.	*Solar Observatory Office, Pasadena, Cal.*	1902
HALL, EDWIN H.	*Harvard University, Cambridge, Mass.*	1911
HALL, GRANVILLE STANLEY	*Clark University, Worcester, Mass.*	1915
HALSTED, WILLIAM STEWART,	*Johns Hopkins Med. School, Baltimore, Md.*	1917
HARPER, R. A.	*Columbia University, New York City.*	1911
HARRISON, ROSS G.	*Yale University, New Haven, Conn.*	1913
HASTINGS, CHARLES S.	*Yale University, New Haven, Conn.*	1889
HAYFORD, JOHN F.	*Northwestern University, Evanston, Ill.*	1911
HEKTOEN, LUDVIG	*629 South Wood St., Chicago, Ill.*	1918
HERRICK, CHARLES JUDSON	*University of Chicago, Chicago, Ill.*	1918
HILLEBRAND, WILLIAM F.	*Bureau of Standards, Washington, D. C.*	1908
HOLMES, WILLIAM H.	*U. S. National Museum, Washington, D. C.*	1905
HOWARD, LELAND OSSIAN	*U. S. Dept. of Agriculture, Washington, D. C.*	1916
HOWE, HENRY MARION	*Broad Brook Road, Bedford Hills, N. Y.*	1917
HOWELL, WILLIAM H.	*Johns Hopkins University, Baltimore, Md.*	1905
IDDINGS, JOSEPH P.	*U. S. Geological Survey, Washington, D. C.*	1907
JACKSON, CHARLES L.	*6 Boylston Hall, Cambridge, Mass.*	1883
JENNINGS, HERBERT SPENCER	*Johns Hopkins University, Baltimore, Md.*	1914
JEWETT, FRANK BALDWIN	*Western Electric Co., New York, N. Y.*	1918
JONES, WALTER	*Johns Hopkins University, Baltimore, Md.*	1918
KASNER, EDWARD	*Columbia University, New York City.*	1917
KEMP, JAMES F.	*Columbia University, New York City.*	1911
LANGMUIR, IRVING	*Gen. Electric Co., Schenectady, N. Y.*	1918
LEUSCHNER, ARMIN O.	*University of California, Berkeley, Cal.*	1913
LEVENE, PHŒBUS AARON THEODOR	*Rockefeller Institute, New York City.*	1916
LEWIS, GILBERT N.	*University of California, Berkeley, Cal.*	1913
LILLIE, FRANK RATTRAY	*University of Chicago, Chicago, Ill.*	1915
LINDGREN, WALDEMAR	*Mass. Inst. of Technology, Cambridge, Mass.*	1909
LOEB, JACQUES	*Rockefeller Institute, New York City.*	1910

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		Date of election.
LUSK, GRAHAM	*Cornell University Medical College, New York City.*	1915
LYMAN, THEODORE	*Harvard University, Cambridge, Mass.*	1917
MARK, EDWARD L	*109 Irving St., Cambridge, Mass.*	1903
MAYOR, ALFRED GOLDSBOROUGH	*276 Nassau St., Princeton, N. J.*	1916
MELTZER, SAMUEL JAMES	*Rockefeller Institute, New York City.*	1912
MENDEL, LAFAYETTE B	*262 Canner St., New Haven, Conn.*	1913
MENDENHALL, CHARLES ELWOOD	*University of Wisconsin, Madison, Wis.*	1918
MENDENHALL, THOMAS C	*329 North Chestnut St., Ravenna, Ohio.*	1887
MERRIAM, C. HART	*1919 16th St., Washington, D. C.*	1902
MERRIAM, JOHN CAMPBELL	*University of California, Berkeley, Cal.*	1918
MERRITT, ERNEST	*Cornell University, Ithaca, N. Y.*	1914
MICHAEL, ARTHUR	*219 Parker St., Newton Center, Mass.*	1889
MICHELSON, ALBERT A	*University of Chicago, Chicago, Ill.*	1888
MILLIKAN, ROBERT ANDREWS	*University of Chicago, Chicago, Ill.*	1915
MOORE, ELIAKIM H	*University of Chicago, Chicago, Ill.*	1901
MORGAN, T. H.	*Columbia University, New York City.*	1909
MORLEY, EDWARD W	*West Hartford, Conn.*	1897
MORSE, EDWARD S	*Salem, Mass.*	1876
MORSE, HARMON N	*Johns Hopkins University, Baltimore, Md.*	1907
MOULTON, F. R	*University of Chicago, Chicago, Ill.*	1910
NICHOLS, EDWARD L	*Cornell University, Ithaca, N. Y.*	1901
NICHOLS, ERNEST F	*Yale University, New Haven, Conn.*	1908
NOYES, ARTHUR A	*Mass. Inst. of Technology, Cambridge, Mass.*	1905
NOYES, WILLIAM A	*University of Illinois, Urbana, Ill.*	1910
OSBORN, H. F	*American Museum of Natural History, New York City.*	1900
OSBORNE, T. B	*Agricultural Experiment Station, New Haven, Conn.*	1910
OSGOOD, WILLIAM FOGG	*Harvard University, Cambridge, Mass.*	1904
PARKER, GEORGE H	*16 Berkeley St., Cambridge, Mass.*	1913
PEARL, RAYMOND	*School of Hygiene and Public Health, 310 West Monument St., Baltimore, Md.*	1916
PICKERING, EDWARD C	*Harvard College Observatory, Cambridge, Mass.*	1873
PIERSON, LOUIS V	*41 Trumbull St., New Haven, Conn.*	1913
PRUDDEN, T. MITCHELL	*Columbia University, New York City.*	1901
PUMPELLY, RAPHAEL	*Gibbs Avenue, Newport, R. I.*	1872
PUPIN, MICHAEL I	*Columbia University, New York City.*	1905
RANSOME, FREDERICK LESLIE	*U. S. Geological Survey, Washington, D. C.*	1914
REID, H. FIELDING	*Johns Hopkins University, Baltimore, Md.*	1912
REMSEN, IRA	*Johns Hopkins University, Baltimore, Md.*	1882
RICHARDS, THEODORE W	*Wolcott Gibbs Mem. Lab., Cambridge, Mass.*	1899
RIDGWAY, ROBERT	*1030 South Morgan St., Olney, Ill.*	1917
ROSA, EDWARD B	*Bureau of Standards, Washington, D. C.*	1913
RUSSELL, HENRY NORRIS	*Princeton University, Princeton, N. J.*	1918
SABINE, WALLACE C	*Harvard University, Cambridge, Mass.*	1917
SARGENT, CHARLES S	*Arnold Arboretum, Jamaica Plain, Mass.*	1895
SCHLESINGER, FRANK	*Allegheny Observatory, Alelgheny, Pa.*	1916
SCHUCHERT, CHARLES	*Yale University, New Haven, Conn.*	1910
SCOTT, WILLIAM B	*Princeton University, Princeton, N. J.*	1906
SMITH, ALEXANDER	*Columbia University, New York City.*	1915
SMITH, EDGAR F	*University of Pennsylvania, Philadelphia, Pa.*	1899
SMITH, ERWIN F	*Bureau of Plant Industry, Washington, D. C.*	1913
SMITH, THEOBALD	*Princeton, N. J.*	1908
STIEGLITZ, JULIUS	*University of Chicago, Chicago, Ill.*	1911

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		Date of election.
STORY, WILLIAM E.	*Clark University, Worcester, Mass.*	1908
STRATTON, SAMUEL WESLEY	*Bureau of Standards, Washington, D. C.*	1917
TAYLOR, DAVID WATSON	*Department of the Navy, Washington, D. C.*	1918
THAXTER, ROLAND	*Harvard University, Cambridge, Mass.*	1912
THOMSON, ELIHU	*Swampscott, Mass.*	1907
THORNDIKE, EDWARD LEE	*Columbia University, New York City.*	1917
TRELEASE, WILLIAM	*University of Illinois, Urbana, Ill.*	1902
TROWBRIDGE, JOHN	*Harvard University, Cambridge, Mass.*	1878
ULRICH, EDWARD OSCAR	*U. S. Geological Survey, Washington, D. C.*	1917
VAN VLECK, E. B.	*University of Wisconsin, Madison, Wis.*	1911
VAUGHAN, VICTOR CLARENCE	*University of Michigan, Ann Arbor, Mich.*	1915
VERRILL, A. E.	*53 Rolston St., Whitneyville, Conn.*	1872
WALCOTT, CHARLES D.	*Smithsonian Institution, Washington, D. C.*	1896
WEBSTER, ARTHUR G.	*Clark University, Worcester, Mass.*	1903
WELCH, WILLIAM H.	*307 St. Paul St., Baltimore, Md.*	1895
WELLS, HORACE L.	*Yale University, New Haven, Conn.*	1903
WHEELER, WILLIAM M.	*Harvard University, Cambridge, Mass.*	1912
WHITE, DAVID	*U. S. Geological Survey, Washington, D. C.*	1912
WHITE, HENRY SEELY	*Vassar College, Poughkeepsie, N. Y.*	1915
WHITNEY, WILLIS RODNEY	*General Electric Co., Schenectady, N. Y.*	1917
WILSON, EDMUND B.	*Columbia University, New York City.*	1899
WOOD, HORATIO C.	*4107 Chester Avenue, Philadelphia, Pa.*	1879
WOOD, ROBERT W.	*Johns Hopkins University, Baltimore, Md.*	1912
WOODWARD, ROBERT S.	*Carnegie Institution, Washington, D. C.*	1896

HONORARY MEMBERS.

SMITH, SIDNEY I.	*Yale University, New Haven, Conn.*	1884

FOREIGN ASSOCIATES.

ARRHENIUS, S. A.	*Nobelinstitut, Stockholm.*	1908
BARROIS, CHARLES	*Université, Lille.*	1908
BRØGGER, W. C.	*Universitet, Christiania.*	1903
CROOKES, SIR WILLIAM	*London.*	1913
DESLANDRES, HENRI	*Astrophysical Observatory, Meudon.*	1913
DEWAR, SIR JAMES	*University, Cambridge.*	1907
FISCHER, EMIL	*Chemisches Institut der Universität, Berlin.*	1904
FORSYTH, A. R.	*Imperial College of Science and Technology, London.*	1907
GEIKIE, SIR ARCHIBALD	*Haslemere, Surrey.*	1901
GROTH, PAUL VON	*Universität, Munich.*	1905
HEIM, ALBERT	*Zürich.*	1913
HILBERT, DAVID	*Universität, Göttingen.*	1907
KAPTEYN, JOHN C.	*Rijks Universiteit, Groningen.*	1907
KLEIN, FELIX	*Universität, Göttingen.*	1898
KÖSSEL, ALBRECHT	*Heidelberg.*	1913
KUSTNER, KARL FRIEDRICH	*Bonn.*	1913
LANKESTER, SIR E. RAY	*South Kensington, London.*	1903
LARMOR, SIR JOSEPH	*St. Johns College, Cambridge.*	1908
LORENTZ, HENDRIK ANTON	*Rijks Universiteit, Leiden.*	1906
OSTWALD, WILHELM	*Grossbothen, bei Leipzig.*	1906
PAVLOV, IVAN PETROVITCH	*Inst. for Experimental Medicine, Petrograd.*	1908
PENCK, ALBRECHT	*Universität, Berlin.*	1909

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		Date of election.
PFEFFER, WILHELM	*Botanische Institut der Universität, Leipzig.*	1903
PICARD, CHARLES ÉMILE	*Université, Paris.*	1903
RAYLEIGH, LORD	*University, Cambridge.*	1898
RETZIUS, GUSTAV	*Högskolan, Stockholm.*	1909
RUTHERFORD, SIR ERNEST	*University, Manchester.*	1911
SCHUSTER, ARTHUR	*Secretary of the Royal Society, London.*	1913
SEELIGER, HUGO RITTER VON	*Universität, Munich.*	1908
THOMSON, SIR JOSEPH	*University, Cambridge.*	1903
VOLTERRA, VITO	*Università, Rome.*	1911
VRIES, HUGO DE	*Universiteit, Amsterdam.*	1904
WAALS, JOHANNES D. VAN DER	*Amsterdam.*	1913
WALEYER, WILHELM	*Universität, Berlin.*	1909
WOLF, MAX F. J. C.	*Heidelberg.*	1913
WUNDT, WILHELM	*Universität, Leipzig.*	1909

DECEASED MEMBERS.

	Date of election.	Date of death.
ABBE, CLEVELAND	1878 [2]	Oct. 28, 1916
AGASSIZ, ALEXANDER	1866	Mar. 27, 1910
AGASSIZ, LOUIS	(1)	Dec. 14, 1873
ATKINSON, GEORGE FRANCIS	1918	Nov. 14, 1918
ALEXANDER, J. H.	(1)	Mar. 2, 1867
ALEXANDER, STEPHEN	(1)	June 25, 1883
BACHE, ALEXANDER DALLAS	(1)	Feb. 14, 1867
BAIRD, SPENCER F.	1864	Aug. 19, 1887
BARKER, GEORGE F.	1876 [2]	May 24, 1910
BARNARD, F. A. P.	(1) (2)	Apr. 27, 1889
BARNARD, J. G.	(1)	May 14, 1882
BARTLETT, W. H. C.	(1)	Feb. 11, 1908
BEECHER, CHARLES EMERSON	1899	Feb. 14, 1904
BILLINGS, JOHN S.	1883	Mar. 11, 1913
BÔCHER, MAXIME	1909	Sept. 12, 1918
BOSS, LEWIS	1889 [2]	Oct. 5, 1912
BOWDITCH, HENRY P.	1887 [2]	Mar. 13, 1911
BREWER, WILLIAM H.	1880 [2]	Nov. 2, 1910
BROOKS, WILLIAM KEITH	1884	Nov. 12, 1908
BROWN-SEQUARD, CHARLES E.	1868	Apr. 2, 1894
BRUSH, GEORGE JARVIS	1868 [2]	Feb. 6, 1912
CASEY, THOMAS L.	1890	Mar. 25, 1896
CASWELL, ALEXIS	(1)	Jan. 8, 1877
CHANDLER, SETH CARLO	1888 [2]	Dec. 31, 1913
CHAUVENET, WILLIAM	(1)	Dec. 13, 1870
CLARK, HENRY JAMES	1872	July 1, 1873
CLARK, WILLIAM B.	1908 [2]	July 27, 1917
COFFIN, JAMES H.	1869	Feb. 6, 1873
COFFIN, J. H. C.	(1)	Jan. 8, 1900
COMSTOCK, CYRUS B.	1884	May 29, 1910
COOK, GEORGE H.	1887	Sept. 22, 1889
COOKE, JOSIAH P.	1872	Sept. 3, 1894
COPE, EDWARD D.	1872 [2]	Apr. 12, 1897
COUES, ELLIOTT	1877	Dec. 25, 1899
CRAFTS, JAMES M.	1872 [2]	June 21, 1917

[1] Charter members, Mar. 3, 1863. [2] Biographical notices have not been presented.

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DECEASED MEMBERS—Continued.

	Date of election.	Date of death.
DALTON, J. C.	1864	Feb. 2, 1889
DANA, JAMES D.	(1) (2)	Apr. 14, 1895
DAVIDSON, GEORGE.	1874 [2]	Dec. 2, 1911
DAVIS, CHARLES H.	(1)	Feb. 18, 1877
DRAPER, HENRY.	1877	Nov. 20, 1882
DRAPER, JOHN W.	1877	Jan. 4, 1882
DUTTON, C. E.	1884 [2]	Jan. 4, 1912
EADS, JAMES B.	1872	Mar. 8, 1887
EMMONS, SAMUEL F.	1892	Mar. 28, 1911
ENGLEMANN, GEORGE.	(1)	Feb. 4, 1884
FERREL, WILLIAM.	1868	Sept. 18, 1891
FRASER, JOHN FRIES.	(1)	Oct. 12, 1872
GABB, WILLIAM M.	1876	May 30, 1878
GENTH, F. A.	1872	Feb. 2, 1893
GIBBS, JOSIAH WILLARD.	1879	Apr. 28, 1903
GIBBS, WOLCOTT.	(1)	Dec. 9, 1908
GILBERT, GROVE KARL.	1883	May 1, 1918
GILL, THEODORE NICHOLAS.	1873	Sept. 25, 1914
GILLISS, JAMES MELVILLE.	(1)	Feb. 9, 1865
GOODE, G. BROWN.	1888	Sept. 6, 1896
GOULD, AUGUSTUS A.	(1)	Sept. 15, 1866
GOULD, BENJAMIN A.	(1) (2)	Nov. 26, 1896
GRAY, ASA.	(1)	Jan. 30, 1888
GUYOT, ARNOLD.	(1)	Feb. 8, 1884
HADLEY, JAMES.	1872	Nov. 14, 1872
HAGUE, ARNOLD.	1885 [2]	May 15, 1917
HALDEMAN, S. S.	1876	Sept. 20, 1880
HALL, ASAPH.	1875	Nov. 22, 1907
HALL, JAMES.	(1) (2)	Aug. 7, 1898
HAYDEN, F. V.	1873	Dec. 22, 1887
HENRY, JOSEPH.	(1)	May 13, 1878
HILGARD, EUGENE W.	1872 [2]	Jan. 8, 1916
HILGARD, JULIUS E.	(1)	May 9, 1890
HILL, GEORGE WILLIAM.	1874	Apr. 16, 1914
HILL, HENRY B.	1883	Apr. 6, 1903
HITCHCOCK, EDWARD.	(1)	Feb. 27, 1864
HOLBROOK, J. E.	1868	Sept, 8 1871
HOLDEN, EDWARD SINGLETON.	1885	Mar. 16, 1914
HUBBARD, J. S.	(1)	Aug. 16, 1863
HUMPHREYS, A. A.	(1)	Dec. 27, 1883
HUNT, T. STERY.	1873 [2]	Feb. 12, 1892
HYATT, ALPHEUS.	1875	Jan. 15, 1902
JAMES, WILLIAM [3].	1903	Aug. 26, 1910
JOHNSON, S. W.	1866	July 21, 1909
KEELER, J. E.	1900	Aug. 12, 1900
KING, CLARENCE.	1876	Dec. 24, 1901
KIRTLAND, JARED P.	1865	Dec. 10, 1877
LANE, J. HOMER.	1872	May 3, 1880
LANGLEY, SAMUEL P.	1876	Feb. 27, 1906
LEA, MATTHEW CAREY.	1892	Mar. 15, 1897
LE CONTE, JOHN.	1878	Apr. 29, 1891
LE CONTE, JOHN L.	(1)	Nov. 15, 1883
LE CONTE, JOSEPH.	1875	July 6, 1901

(1) Charter members, Mar 3, 1863.
(2) Biographical notices have not been presented
[3] Resigned in 1908 or 1909.

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DECEASED MEMBERS—Continued.

	Date of election.	Date of death.
LEIDY, JOSEPH	(1)	Apr. 30, 1891
LESLEY, J. PETER	(1)	June 1, 1903
LESQUEREUX, LEO	1864	Oct. 20, 1889
LONGSTRETH, MIERS F	(1)	Dec. 27, 1891
LOOMIS, ELIAS	1873	Aug. 15, 1889
LOVERING, JOSEPH	1873	Jan. 18, 1892
LYMAN, THEODORE	1872	Sept. 9, 1897
MAHAN, D. H	(1)	Sept. 16, 1871
MALL, FRANKLIN P	1907 [2]	Nov. 17, 1917
MARSH, G. P	1866	July 23, 1882
MARSH, O. C	1874 [2]	Mar. 18, 1899
MAYER, ALFRED M	1872	July 13, 1897
MAYO-SMITH, RICHMOND	1890 [2]	Nov. 11, 1901
MEEK, F. B	1869	Dec. 21, 1876
MEIGS, M. C	1865	Jan. 2, 1892
MINOT, CHARLES SEDGWICK	1897 [2]	Nov. 19, 1914
MITCHELL, HENRY	1885 [2]	Dec. 1, 1902
MITCHELL, SILAS WEIR	1865 [2]	Jan. 4, 1914
MORGAN, LEWIS H	1875	Dec. 17, 1881
MORTON, HENRY	1874	May 9, 1902
NEF, JOHN ULRIC	1904 [2]	Aug. 13, 1915
NEWBERRY, J. S	(1)	Dec. 7, 1892
NEWCOMB, SIMON	1869 [2]	July 11, 1909
NEWTON, H. A	(1)	Aug. 12, 1896
NEWTON, JOHN	1876	May 1, 1895
NORTON, WILLIAM A	1873	Sept. 21, 1883
OLIVER, JAMES E	1872	Mar. 27, 1895
PACKARD, A. S	1872 [2]	Feb. 14, 1905
PENFIELD, SAMUEL L	1900	Aug. 13, 1906
PETERS, C. H. F	1876 [2]	July 18, 1890
PEIRCE, BENJAMIN [3]	(1)(3)	Oct. 6, 1880
PEIRCE, BENJAMIN OSGOOD	1906 [2]	Jan. 14, 1914
PIERCE, CHARLES SANTIAGO SANDERS	1876 [2]	Apr. 20, 1914
POURTALES, L. F	1873	July 19, 1880
POWELL, JOHN W	1880	Sept. 23, 1902
PUTNAM, FREDERICK W	1885 [2]	Aug. 18, 1915
RODGERS, JOHN	(1)	May 5, 1882
ROGERS, FAIRMAN	(1)	Aug. 22, 1900
ROGERS, ROBERT E. [4]	(1)	Sept. 6, 1884
ROGERS, WILLIAM A	1885	Mar. 1, 1898
ROGERS, WILLIAM B. [5]	(1)	May 30, 1882
ROOD, OGDEN N	1865	Nov. 12, 1902
ROWLAND, HENRY A	1881	Apr. 16, 1901
ROYCE, JOSIAH	1906 [2]	Sept. 14, 1916
RUTHERFURD, LEWIS M	(1)	May 30, 1892
SAXTON, JOSEPH	(1)	Oct. 26, 1873
SCHOTT, CHARLES A	1872	July 31, 1901
SCUDDER, SAMUEL H	1877 [2]	May 17, 1911
SELLERS, WILLIAM	1873 [2]	Jan. 24, 1905
SILLIMAN, BENJ., Sr	(1)	Nov. 24, 1864
SILLIMAN, BENJ., Jr	(1)	Jan. 14, 1885
SMITH, J. LAWRENCE	1872	Oct. 12, 1883

[1] Charter members, Mar. 3, 1863.
[2] Biographical notices have not been presented.
[3] Resigned 1873.
[4] Dropped —, reelected 1875.
[5] Dropped —, reelected 1872.

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DECEASED MEMBERS—Continued.

	Date of election.	Date of death.
Stimpson, William	1858 [2]	May 26, 1872
Strong, Theodore	(1)	Feb. 1, 1869
Sullivant, W. S.	1872	Apr. 30, 1873
Torrey, John	(1)	Mar. 10, 1873
Totten, J. G.	(1)	Apr. 22, 1864
Trowbridge, William P.	1872	Aug. 12, 1892
Trumbull, James H.	1872	Aug. 5, 1897
Tuckerman, Edward	1868	Mar. 15, 1886
Van Hise, C. R.	1902	Nov. 19, 1918
Walker, Francis A.	1878	Jan. 5, 1897
Warren, G. K.	1876	Aug. 8, 1882
Watson, James C.	1868	Nov. 23, 1880
Watson, Sereno	1889	Mar. 9, 1892
Wheeler, Henry Lord	1909 [2]	Oct. 30, 1914
White, Charles A.	1889	June 29, 1910
Whitman, C. O.	1895	Dec. 6, 1910
Whitney, Josiah D. [3]	(1) (2)	Aug. 19, 1896
Whitney, William D. [3]	1865 [2]	June 29, 1894
Williston, Samuel Wendell	1915	Aug. 30, 1918
Winlock, Joseph	(1)	June 11, 1875
Woodward, J. J.	1873	Aug. 17, 1884
Worthen, A. H.	1872	May 6, 1888
Wright, Arthur Williams	1881 [2]	Dec. 19, 1915
Wyman, Jeffries	(1)	Sept. 4, 1874
Young, Charles A.	1872	Jan. 3, 1908

[1] Charter members, Mar. 3, 1863. [2] Biographical notices have not been presented. [3] Resigned.

DECEASED FOREIGN ASSOCIATES.

Adams, J. C.
Airy, Sir George B.
Argelander, F. W. A.
Auwers, G. F. J. Arthur
Backlund, Oskar
Baer, Karl Ernest von
Baeyer, Adolf von
Barrande, Joachin
Beaumont, L. Élie de
Becquerel, Henri
Berthelot, M. P. E.
Bertrand, J. L. F.
Boltzmann, Ludwig
Bornet, Edouard
Boussingault, J. B. J. D.
Boveri, Theodor
Braun, Alexander
Brewster, Sir David
Bunsen, Robert W.
Burmeister, C. H. C.
Candolle, Alphonse de
Cayley, Arthur
Chasles, Michel
Chevreul, M. E.
Clausius, Rudolph
Cornu, Alfred
Darboux, Gaston
Darwin, Sir George Howard
Dove, H. W.
Dumas, J. B.
Ehrlich, Paul
Faraday, Michael
Gegenbaur, Karl
Glydén, Hugo
Gill, Sir David
Hamilton, Sir William Rowan
Helmholtz, Baron H. von
Hoff, J. H. van't
Hofmann, A. W.
Hooker, Sir Joseph D.
Huggins, Sir William
Huxley, T. H.
Ibañez, Carlos
Janssen, J.

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JOULE, JAMES P.
KEKULÉ, AUGUST
KELVIN, LORD
KIRCHOFF, G. R.
KOCH, ROBERT
KÖLLIKER, ALBERT VON
KOHLRAUSCH, FRIEDRICH
KRONECKER, HUGO
LACAZE-DUTHIERS, HENRI DE
LEUCKART, RUDOLPH
LIE, SOPHUS
LIEBIG, JUSTUS VON
LISTER, LORD
LOEWY, MAURICE
LUDWIG, K. F. W.
MAREY, E. J.
MENDELÉEFF, D. I.
MILNE-EDWARDS, HENRI
MOISSAN, HENRI
MURCHISON, SIR RODERICK I.
MURRAY, SIR JOHN
OPPOLZER, THEODORE VON
OWEN, SIR RICHARD
PASTEUR, LOUIS
PETERS, C. A. F.
PLANA, G. A. A.
POINCARÉ, JULES HENRI
RAMMELSBERG, C. F.
RAMSAY, SIR WILLIAM
REGNAULT, VICTOR
REYMOND, EMIL DU BOIS
RICHTHOFEN, F. VON
ROSENBUSCH, KARL HARRY FERDINAND
SACHS, JULIUS VON
SCHIAPARELLI, GIOVANNI
STAS, JEAN SERVAIS
STOKES, SIR GEORGE G.
STRASBURGER, EDOUARD
STRUVE, OTTO VON
SUESS, EDUARD
SYLVESTER, J. J.
TISSERAND, F. F.
VIRCHOW, RUDOLPH VON
VOGEL, H. C.
WEIERSTRASS, KARL
WEISMANN, AUGUST
WÖHLER, FRIEDRICH
WÜRTZ, ADOLPH
ZIRKEL, FERDINAND
ZITTELL, K. A. R. VON

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REPORT

OF THE

NATIONAL ACADEMY OF SCIENCES

FOR THE YEAR

1919

WASHINGTON
GOVERNMENT PRINTING OFFICE
1920

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REPORT

OF THE

NATIONAL ACADEMY OF SCIENCES

FOR THE YEAR

1919

WASHINGTON
GOVERNMENT PRINTING OFFICE
1920

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CONTENTS.

	Page.
Letter of transmittal	7
Act of incorporation	8
Amendments	9
Meetings of the National Academy, 1919	11
Annual meeting	11
Members in attendance	11
Business sessions	12
Announcements by the president	12
Assignment of biographies	13
Changes in personnel of sections and committees	13
Report of the treasurer	13
Report of the acting home secretary	13
Report of the foreign secretary	15
Report of the directors of the Bache fund	15
Report of the committee on the Henry Draper fund	16
Report of the trustees of the Watson fund	16
Report of the committee on the J. Lawrence Smith fund	17
Report of the directors of the Benjamin Apthorp Gould fund	18
Report of the directors of the Wolcott Gibbs fund	18
Report of the committee on the Murray fund	19
Report of the committee on the Marcellus Hartley fund	19
Report of the committee on the Marsh fund	19
Report of the committee on the Elliot prize	20
Report of the editorial board of the Proceedings	20
Organization of the National Research Council	22
Resignation of treasurer	27
Election of officers and members	27
Announcement of medals	28
Academy of Humanistic Science	28
Scientific sessions	29
April 28	29
April 29	30
April 30	31
Autumn meeting	31
Members in attendance	31
Business sessions	31
Announcement of deaths	31
Section of engineering established	32
Auditing committee	32
Editorial board	32
The Mary Clark Thompson gold medal	32
Awards	33
Organization of the National Research Council	33
Kilauea volcano investigations	34
Presentation of the Elliot medal	37

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Meetings of the National Academy, 1919—Continued.
Autumn meeting—Continued. Page.
Scientific sessions ---- 37
November 10 ---- 37
November 11 ---- 38
November 12 ---- 39
Deceased members—
George Francis Atkinson ---- 39
Joseph Barrell ---- 41
George Ferdinand Becker ---- 44
Maxime Bôcher ---- 49
William Gilson Farlow ---- 50
Edward Charles Pickering ---- 52
Wallace Clement Ware Sabine ---- 57
Emil Fischer ---- 61
Lord Rayleigh ---- 63
Report of the National Research Council ---- 65
Gifts to the council ---- 66
General policies ---- 70
Report of the committee on general policy and solicitation of funds ---- 70
Publications ---- 72
Relations between two main groups of divisions ---- 74
Council quarters ---- 75
Reports of divisions ---- 75
Divisions of general relations ---- 75
Government division ---- 75
Division of foreign relations ---- 76
Division of States relations ---- 77
Division of educational relations ---- 78
Division of research extension ---- 80
Research information service ---- 83
Divisions of science and technology ---- 85
Division of physical sciences ---- 85
Division of engineering ---- 86
Division of chemistry and chemical technology ---- 93
Division of geology and geography ---- 97
Division of medical sciences ---- 98
Division of biology and agriculture ---- 100
Division of anthropology and psychology ---- 101
Appendix A—Organization of the National Research Council ---- 104
Divisions ---- 104
Officers ---- 104
Executive board ---- 104
Members ex officio ---- 104
Members at large ---- 105
Members of the divisions ---- 105
Divisions of general relations ---- 105
Government division ---- 105
Division of foreign relations ---- 106
Division of States relations ---- 108
Division of educational relations ---- 110
Division of research extension ---- 111
Research information service ---- 112

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Report of the National Research Council—Continued.
Appendix A—Organization of the National Research Council—Contd.
Members of the divisions—Continued. Page.
Divisions of science and technology 113
Division of physical sciences 113
Division of engineering 115
Division of chemistry and chemical technology 117
Division of geology and geography 119
Division of medical sciences 121
Division of biology and agriculture 123
Division of anthropology and psychology 125
Research fellowship board 126
Members of the board 126
Ex officio 127
Fellows 127
Appendix B 127
Annual report of the treasurer 130
General review of financial transactions 130
National Academy of Sciences 131
Trust funds of the Academy 134
Statement of assets and liabilities 135
Condensed statement of receipts and expenditures 138
Accounts with individual funds 140
National Research Council 145
Receipts and disbursements 146
Report of the auditing committee 149
Appendixes 151
Appendix A—Constitution of the National Academy 153
Appendix B—Rules 161
Appendix C—Organization of the Academy, 1919–20 167
Sections 167
Standing committees 169
Trust funds 169
Members of the National Academy of Sciences, December 31, 1919 172
Honorary member 175
Foreign associates 175
Deceased members 176
Deceased foreign associates 179

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LETTER OF TRANSMITTAL.

NATIONAL ACADEMY OF SCIENCES,
February 25, 1920.

Hon. THOMAS R. MARSHALL,
Vice President of the United States,
Washington, D. C.

SIR: I have the honor to transmit to you herewith the annual report of the president of the National Academy of Sciences for the year ending December 31, 1919.

Very respectfully,

CHARLES D. WALCOTT,
President.

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ACT OF INCORPORATION.

AN ACT To incorporate the National Academy of Sciences.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That Louis Agassiz, Massachusetts; J. H. Alexander, Maryland; S. Alexander, New Jersey; A. D. Bache, at large; F. B. Barnard,[1] at large; J. G. Barnard, United States Army, Massachusetts; W. H. C. Bartlett, United States Military Academy, Missouri, U. A. Boyden,[2] Massachusetts; Alexis Caswell, Rhode Island; William Chauvenet, Missouri; J. H. C. Coffin, United States Naval Academy, Maine; J. A. Dahlgren,[2] United States Navy, Pennsylvania; J. D. Dana, Connecticut; Charles H. Davis, United States Navy, Massachusetts; George Englemann, Saint Louis, Missouri; J. F. Frazer, Pennsylvania; Wolcott Gibbs, New York; J. M. Giles,[3] United States Navy, District of Columbia; A. A. Gould, Massachusetts; B. A. Gould, Massachusetts; Asa Gray, Massachusetts; A. Guyot, New Jersey; James Hall, New York; Joseph Henry, at large; J. E. Hilgard, at large, Illinois; Edward Hitchcock, Massachusetts; J. S. Hubbard, United States Naval Observatory, Connecticut; A. A. Humphreys, United States Army, Pennsylvania; J. L. Le Conte, United States Army, Pennsylvania; J. Leidy, Pennsylvania; J. P. Lesley, Pennsylvania; M. F. Longstreth, Pennsylvania; D. H. Mahan, United States Military Academy, Virginia; J. S. Newberry, Ohio; H. A. Newton, Connecticut; Benjamin Peirce, Massachusetts; John Rodgers, United States Navy, Indiana; Fairman Rogers, Pennsylvania; R. E. Rogers, Pennsylvania; W. B. Rogers, Massachusetts; L. M. Rutherford, New York; Joseph Saxton, at large; Benjamin Silliman, Connecticut; Benjamin Silliman, junior, Connecticut; Theodore Strong, New Jersey; John Torrey, New York; J. G. Totten, United States Army, Connecticut; Joseph Winlock, United States Nautical Almanac, Kentucky; Jeffries Wyman, Massachusetts; J. D. Whitney, California; their associates and successors duly chosen, are hereby incorporated, constituted, and declared to be a body corporate, by the name of the National Academy of Sciences.

[1] The official list of members gives the name of F. A. P. Barnard.
[2] Declined.
[3] The official list of members gives the name of J. M. Gillis.

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SEC. 2. *And be it further enacted*, That the National Academy of Sciences shall consist or not more than fifty ordinary members, and the said corporation hereby constituted shall have power to make its own organization, including its constitution, by-laws, and rules and regulations; to fill all vacancies created by death, resignation, or otherwise; to provide for the election of foreign and domestic members, the division into classes, and all other matters needful or usual in such institution, and to report the same to Congress.

SEC. 3. *And be it further enacted*, That the National Academy of Sciences shall hold an annual meeting at such place in the United States as may be designated, and the academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art, the actual expense of such investigations, examinations, experiments, and reports to be paid from appropriations which may be made for the purpose, but the academy shall receive no compensation whatever for any services to the Government of the United States.

SOLOMON FOOTE,
President of the Senate pro tempore.
GALUSHA A. GROW,
Speaker of the House of Representatives.

Approved, March 3, 1863.

ABRAHAM LINCOLN, *President.*

AMENDMENTS.

AN ACT To amend the act to incorporate the National Academy of Sciences.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the act to incorporate the National Academy of Sciences, approved March third, eighteen hundred and sixty-three, be, and the same is hereby, so amended as to remove the limitation of the number of ordinary members of said academy as provided in said act.

Approved, July 14, 1870.

AN ACT To authorize the National Academy of Sciences to receive and hold trust funds for the promotion of science, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the National Academy of Sciences, incorporated by the act of Congress, approved March third, eighteen hundred and sixty-three, and its several supplements, be, and the same is hereby, authorized and empowered to receive bequests and donations and hold the same in trust, to be applied by the said academy in aid of scientific investigations and according to the will of the donors.

Approved, June 20, 1884.

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AN ACT To amend the act authorizing the National Academy of Sciences to receive and hold trust funds for the promotion of science, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the act to authorize the National Academy of Sciences to receive and hold trust funds for the promotion of science, and for other purposes, approved June twentieth, eighteen hundred and eighty-four, be, and the same is hereby, amended to read as follows:

"That the National Academy of Sciences, incorporated by the act of Congress approved March third, eighteen hundred and sixty-three, be, and the same is hereby, authorized and empowered to receive, by devise, bequest, donation, or otherwise, either real or personal property, and to hold the same absolutely or in trust, and to invest, reinvest, and manage the same in accordance with the provisions of its constitution, and to apply said property and the income arising therefrom to the objects of its creation and according to the instructions of the donors: *Provided, however*, That the Congress may at any time limit the amount of real estate which may be acquired and the length of time the same may be held by said National Academy of Sciences."

SEC. 2. That the right to alter, amend, or repeal this act is hereby expressly reserved.

Approved, May 27, 1914.

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ANNUAL REPORT

OF THE

NATIONAL ACADEMY OF SCIENCES.

MEETINGS OF THE NATIONAL ACADEMY.

During the year 1919 the Academy held two stated meetings, the annual meeting in April, at Washington, and the autumn meeting in November, at New Haven, Conn.

ANNUAL MEETING.

The annual meeting of the Academy was held at the Smithsonian Institution in Washington, April 28, 29, and 30, 1919.

Seventy members were present. as follows:

Abbot, C. G.
Aitken, R. G.
Ames, J. S.
Benedict, R. G.
Birkhoff, G. D.
Boas, Franz
Bumstead, H. A.
Cannon, W. B.
Cattell, J. McK.
Clarke, F. W.
Clarke, J. M.
Conklin, E. G.
Cross, Whitman
Cushing, Harvey
Dall, Wm. H.
Davenport, C. B.
Davis, W. M.
Day, Arthur L.
Dickson, L. E.
Fewkes, J. Walter
Flexner, Simon
Forbes, S. A.
Hale, George E.
Hall, Edwin H.
Hayford, J. F.
Hillebrand, W. F.
Holmes, W. H.
Howard, L. O.
Howe, H. M.
Iddings, J. P.
Jennings, H. S.
Jewett, F. B.
Kasner, Edward
Langmuir, Irving
Leuschner, A. O.
Loeb, Jacques
Lusk, Graham
Mayor, A. G.
Mendel, L. B.
Merriam, C. H.
Merriam, J. C.
Millikan, R. A.
Morgan, T. H.
Moulton, F. R.
Nichols, E. L.
Nichols, E. F.
Noyes, A. A.
Noyes, W. A.
Osborne, T. B.
Osborn, H. F.
Pearl, Raymond
Ransome, F. L.
Reid, H. Fielding
Rosa, E. B.
Russell, H. N.
Schlesinger, Frank
Schuchert, Charles
Smith, Erwin F.
Stieglitz, Julius
Stratton, S. W.
Thorndike, E. L.
Ulrich, E. O.
Van Vleck, E. B.
Vaughan, V. C.
Walcott, C. D.
Webster, A. G.
Wheeler, W. M.
White, David
White, H. S.
Woodward, R. S.

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BUSINESS SESSIONS.

ANNOUNCEMENTS BY THE PRESIDENT.

In accordance with the Executive order of the President of the United States of May 11, 1918, the organization of the National Research Council, bringing together in a representative body all research organizations of the country, was prepared, presented at a meeting of the Academy, and adopted. This organization has later become affiliated with similar organizations of other nations to form an International Research Council, with American sections.

With increased activities, the pressing need of a home for the Academy, to include the Research Council, was felt more keenly. The Carnegie Corporation, after considering the value of the work of the Academy and of the Research Council to the world, offered $5,000,000 to the National Academy of Sciences to erect a building and to endow the Research Council, provided that the Academy furnish a suitable building site and submit satisfactory building plans.

Friends of the Academy have contributed and, through their munificence, square 88, opposite the Lincoln Memorial in Potomac Park, has been purchased. The lot is bounded by B Street on the south, Twenty-first on the east, Twenty-second on the west, and C Street on the north. It contains 189,163 square feet and was purchased at a total cost of $185,010.21.

At the meeting of the board of trustees of the Carnegie Corporation of New York, on December 19, 1919, resolutions were adopted authorizing the setting aside of $1,000,000 and a further sum not to exceed $400,000 in money for the erection of a building. The remainder of the $5,000,000 forms a fund for the establishment of an income to be used for the expenses of the Academy and the National Research Council. Plans are being prepared for the erection of a building.

Mrs. Mary Clark Thompson has given to the Academy the sum of $10,000, with an additional $1,000 for the designing, striking, and making of dies, to be applied on a medal to be awarded for the most important researches in geology and paleontology.

Requests for advice during the year have been received from the Secretary of Agriculture and from the Senate Committee on Naval Affairs. The request of the former, for advice relative to the conduct of scientific investigations in seismology and volcanology at the Kilauea Volcano, Hawaii, was referred to a committee, a preliminary report prepared and sent to the Secretary of Agiculture, and a final report will be sent in at the beginning of the year. The request from the Senate Committee on Naval Affairs relative to

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underwater and underground radio has been referred to a committee and is now under consideration.

The annual report of the president, containing that of the treasurer for 1918 in printed form was presented, accepted, and distributed to the members.

Tellers to count preference ballots: J. M. Clarke (chairman), H. N. Russell, and Walter Jones.

Assignment of biographies:

	Elected.	Died.	Assigned to—
Members:			
Atkinson, George Francis	1918	Nov. 14, 1918	N. L. Britton.
Becker, George F.	1901	Apr. 20, 1919	A. G. Webster.
Böcher, Maxime	1909	Sept. 12, 1918	Wm. E. Story.
Pickering, Edward C.	1873	Feb. 3, 1919	H. N. Russell.
Sabine, Wallace C. W.	1917	Jan. 10, 1919	Edwin H. Hall.
Van Hise, Charles R.	1902	Nov. 19, 1918	T. C. Chamberlin.
Foreign associate:			
Crookes, Sir William	1913	Apr. 4, 1919	

Changes in personnel of sections and committees:

Local committee: Frederick L. Ransome (chairman), Marston T. Bogert, Armin O. Leuschner, C. Hart Merriam, Ernest F. Nichols, Edward B. Rosa.

Henry Draper fund: W. W. Campbell to succeed himself, term expiring in 1924.

J. Lawrence Smith fund: E. W. Morley to succeed himself, term expiring in 1924; A. O. Leuschner to fill the unexpired term of E. C. Pickering expiring in 1920.

Comstock fund: W. R. Whitney to succeed A. A. Noyes, term expiring in 1924.

Marsh fund: J. C. Merriam to succeed E. H. Moore as chairman and member, term expiring in 1922.

Murray fund: W. M. Davis to succeed himself, term expiring in 1922.

Marcellus Hartley fund: A. A. Noyes, chairman and member, to succeed G. F. Becker, term expiring in 1922; S. W. Stratton to succeed W. F. Hillebrand, term expiring in 1922.

REPORT OF THE TREASURER.

The report of the treasurer was presented in printed form and approved.

REPORT OF THE HOME SECRETARY.

The home secretary presented the following report, which was accepted:

APRIL 28, 1919.

The PRESIDENT OF THE NATIONAL ACADEMY OF SCIENCES,

Washington, D. C.

SIR: I have the honor to present the following report of the acting home secretary on the publications and membership of the National Academy of Sciences for the year ending April 30, 1919.

The exigencies of war have retarded printing in Washington, and for that reason no scientific memoirs have been published during the year. Publica-

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tion has been taken up again, however, and four memoirs are now in preparation.

The Complete Classification of the Triad Systems in Fifteen Elements, by H. S. White, F. N. Cole, and Miss L. D. Cummings, received in manuscript on June 20, 1917, and sent to the Public Printer to be published as Volume XIV, second memoir.

Tables of the Minor Planets—Discoveries by James C. Watson. Part 2: On Von Zeipel's Theory of the Perturbations of the Minor Planets of the Hecuba Group, by A. O. Leuschner, A. E. Glancy, and S. H. Levy, received in manuscript on January 7, 1919, and sent to the Public Printer to be published as Volume XIV, third memoir.

Minor Constituents of Meteorites, by George P. Merrill, received in manuscript on May 11, 1918, and sent to the Public Printer to be published as Volume XIV, fourth memoir.

Tables of the Exponential Function and of the Circular Sine and Cosine to Radian Argument, by C. E. Van Orstrand, received in manuscript May 24, 1918, and sent to the Public Printer to be published as Volume XIV, fifth memoir.

No Biographical Memoirs have been published, owing to pressure of war work, but the following biographies have been sent to the printer and are near completion:

Cleveland Abbe, by W. J. Humphreys, received in manuscript November 7, 1917.

Lewis Boss, by Benjamin Boss, received in manuscript March 20, 1917.

William Bullock Clark, by John M. Clarke, received in manuscript January 2, 1918.

James Mason Crafts, by Charles R. Cross, manuscript received November 10, 1918.

James Dwight Dana, by L. V. Pirsson, received in manuscript November 12, 1917.

Arnold Hague, by J. P. Iddings, received in manuscript August 2, 1918.

Eugene Woldemar Hilgard, by F. Slate, jr., received in manuscript October 11, 1918.

Alpheus Spring Packard, by T. D. A. Cockerell, received in manuscript October 16, 1918.

Benjamin Osgood Peirce, by E. H. Hall, received in manuscript November 20, 1917.

With the publication of these memoirs Volume VIII of the Biographical Memoirs will have been published and ready for distribution, while 2,000 copies of the Third Annual Report of the National Research Council will be issued in a few days. The Proceedings of the Academy have been published regularly and have reached the third number of the fifth volume.

Six members have died since the last meeting: George Francis Atkinson, elected in 1918, died November 14, 1918; George F. Becker, elected in 1901, died April 20, 1919; Maxime Bôcher, elected in 1909, died September 12, 1918; Edward C. Pickering, elected in 1873, died February 3, 1919; Wallace C. W. Sabine, elected in 1917, died January 10, 1919; Charles R. Van Hise, elected in 1902, died November 19, 1918.

One foreign associate, Sir William Crookes, elected in 1913, died April 1, 1919. There are now on the membership list 164 active members, 1 honorary member, and 35 foreign associates.

C. G. ABBOT,
Acting Home Secretary.

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REPORT OF FOREIGN SECRETARY.

The foreign secretary presented a report on the work of his office during the past year, stating that it largely had to do with the organization of the National Research Council and the International Research Council and that this was fully reported on in the work of the National Research Council.

Moved that the report of the foreign secretary be accepted, and the action reported therein of the delegates to the International Research Council be approved.

Adopted.

The following reports on the research funds of the National Academy of Sciences were received and approved:

REPORT OF THE DIRECTORS OF THE BACHE FUND.

Since the annual meeting of the Academy in April, 1918, the following grants have been made:

No. 210. Wayne J. Atwell, University of Buffalo, medical department, $210. For investigation on the development of the human hypophosis cerebri.

No. 211. George H. Shull, Princeton, N. J., $360. For continuation of studies in linkage and other genetical phenomena of Oenothera, and duplication of factors, multiple allelomorphism, and other genetical phenomena in shepherd's-purse.

No. 212. Arthur G. Webster, Clark University, Worcester, Mass., $1,500. For study of the air wave accompanying a projectile.

No. 213. Duncan S. Johnson, Johns Hopkins University, $300. For a study of the behavior and character of the chromosomes at spermatogenesis, etc., in certain tropical liverworts.

A provisional grant of $1,000 was made for another research, but the applicant had meantime started on his trip of exploration and has not been heard from since, so that it is not certain that the money will be required.

The recipient of a grant made some years ago, whose work had not yielded results entirely to his satisfaction, offered to return the money which he had expended, with interest. The directors, however, unanimously declined to accept such return, regarding it as establishing a very unwise precedent which would imply that the recipient of a grant might be personally responsible if a research seriously prosecuted did not yield the results hoped for by him.

Reports of previous grants have been received as follows:

No. 202. W. C. Allee, Lake Forest, Ill. The survey of the effect of the reagents on reactions to light of Mayfly nymphs. Results published, Biol. Bull., 32, 93–97; and Journ. Exp. Zool., 26, 423–459. Further work in progress on reversals to light; cause and effects of aggregation in certain arthropods; effect of cyanides on arthropods.

No. 203. Joseph P. Iddings, Brinklow, Md. The work continues and will not be finished for some time yet.

No. 205. T. H. Goodspeed, Berkeley, Cal. Experiments on Nicotiana. Publication of the final results has been delayed by military and civilian service of the collaborators.

No. 207. T. H. Gronwall. Mathematical investigations. Preliminary results published in the Proceedings of the Academy, 5, 22–24, January, 1919, under the title, "A theorem of power series with an application to conformal mapping." Three notes embodying further results are in preparation and will soon be sent to the editor of the proceedings.

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No. 208. A. F. Shull, Ann Arbor, Mich. Research is concluded on (1) cell inconstancy in hydatina; and (2) relative effectiveness of food, oxygen, etc., in causing or preventing male production. Results published (1) Journ. Morph. 30, No. 2, March, 1918; (2) Journ. Exp. Zool. 26, No. 3, Aug., 1918. Research is still in progress on nuclea volume in relation to life cycle of hydatina; also on phenomena of maturation in relation to life cycle of hydatina; and on rate of metabolism in relation to life cycle of aphids.

No. 209. Cecil K. Drinker, Boston. In addition to the first paper, reported last year, three others will be sent to the Journ. Exp. Medicine during the coming year, based on the study of material which has been accumulated with the aid of this grant.

No. 210. W. J. Atwell, Buffalo, N. Y. A research on the development of human hypophysis cerebri is in progress. Three models have been completed by the Bron wax-late method, showing hypophysis of 10 mm., 16 mm., 30 mm. human embryos.

No. 211. George H. Shull, Princeton, N. J. The studies on heredity in shepherd's-purse and evening primroses are being carried on with a minimum of labor and would have been impossible without the grant.

The American collaborators of the Nomenclator Animalium Generum et Subgenerum have been paid the amounts due for their work.

After reserving $1,000 for the conditional grant referred to above, the balance available for grants on April 1, 1919, is $2,138.80.

EDWIN B. FROST, *Chairman.*

REPORT OF THE COMMITTEE ON THE HENRY DRAPER FUND.

The committee has unanimously recommended to the council that the Henry Draper gold medal be awarded to Prof. Charles Fabry of the University of Marseilles, in recognition of his researches in physics and astronomy, chiefly by means of interferometers.

There have been no applications received for grants from the Henry Draper fund in support of research during the past year. This is probably due in large measure to the facts that many investigators have been engaged upon war problems and that investigators remaining at home have not planned for extensions of instrumental means.

The total amount of income available for the encouragement of research was $2,234.94 on April 1, 1919. Of this sum $382.44 was cash on hand and $1,952.50 was invested in securities.

Respectfully submitted.

W. W. CAMPBELL, *Chairman.*

MOUNT HAMILTON, CALIF., *April 21, 1919.*

REPORT OF THE TRUSTEES OF THE WATSON FUND.

Grant No. 15. A grant of $300 was made in April, 1917, to Prof. Herbert C. Wilson, of Carleton College, Northfield, Minn., for the continuation of the photographic determination of the positions of minor planets. During the past year about 60 plates of minor planets have been secured, but measurement of the positions has been interrupted by loss of assistants. The results obtained under previous grants have been published in publications of the Goodsell Observatory of Carleton College, Nos. 5 and 6, 1917–18, under the title, "Photographic Observations of Asteroids," by H. C. Wilson, C. H. Gingrich, and Julia M. Hawkes (No. 6).

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Grant No. 16. A grant of $500 was made to Prof. John A. Miller, director of the Sproul Observatory of Swarthmore College, Pennsylvania, for the employment of an assistant in measuring and reducing plates for the determination of parallaxes. This fund is being paid to Miss Carolyn H. Smedley, research assistant in the observatory. In the fall she also aided in studying the corona of the eclipse of 1918. The sum of $500 is only part of her salary. The observatory has recently put into press 50 new parallaxes. A great number of series are in process of measurement. Between 20 and 25 additional parallaxes are ready for publication.

The trustees of the Watson fund submit the following recommendations:

Grant No. 17. That the appropriation of $500 to Prof. John A. Miller for the employment of assistance in measuring and reducing plates for the determination of parallaxes be renewed for the year beginning July 1, 1919.

Grant No. 18. That the appropriation of $300 to Prof. Herbert C. Wilson for the employment of assistance in securing, measuring, and reducing photographic positions of minor planets be renewed for the year beginning July 1, 1919.

Grant No. 19. That an appropriation of $500 be made to Prof. J. A. Parkhurst for the employment of assistance in measuring and reducing plates for photographic and photovisual magnitudes in the north polar sequence and in the parallax field on which the Yerkes Observatory is working; the grant to be available during the year beginning June 1, 1919.

A. O. LEUSCHNER, *Chairman.*
G. C. COMSTOCK.
W. L. ELKINS.

WASHINGTON, D. C., *April 26, 1919.*

REPORT OF THE COMMITTEE ON THE J. LAWRENCE SMITH FUND.

Grant No. 4. Prof. C. C. Trowbridge, of the department of physics, Columbia University, N. Y., has received grants amounting to $1,400 to aid in the study of luminous trains of meteors. His lamented and untimely death, in June last, has put an end to this investigation.

An unfinished paper on the spectra of luminous trains has been completed from his notes by a research assistant familiar with the whole investigation, and is now ready for submission to the Academy. Two other papers are to be completed in the same way. One contains a summary of theories hitherto advanced in explanation of meteor trains, and the other discusses certain auroral phenomena and their relation to theories concerning meteor trains.

Two other parts of Prof. Trowbridge's research have probably not gone so far that they can be completed without further investigation. One concerns the drift and diffusion of meteor trains as bearing on the phosphorescent-gas theory; the other concerns the height of meteor trains and its relation to the height of the atmosphere. A large amount of classified information, arranged for convenient reference, has been collected by Prof. Trowbridge, which it is hoped will be utilized by some one who may interest himself in these or cognate matters.

The department of physics in Columbia University has inquired what disposition shall be made of this material, and the committee suggest that it be forwarded to the secretary of the Academy for preservation till it may become useful. We have also requested the research assistant of Prof. Trowbridge to prepare a paper stating the nature and extent of the information contained in this material, which will soon be ready.

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Grant No. 6. Prof. S. A. Mitchell, University of Virginia, University, Va., has received grants amounting to $1,500 to aid in securing observations of meteor paths and radiants, and in computing orbits where the observations suffice. During the last year war-time activities have interrupted this valuable work. It is now resumed, and the unexpended balance of the grant may well be sufficient for a time.

Grant No. 7. Dr. George P. Merrill, of the United States National Museum, in 1917 received a grant of $400 to aid in his study of the presence of certain elements in meteorites. War activities have hindered his research, so that no progress can be reported for the past year.

There is now $850.39 cash in hand, as well as $2,032.50 invested income, making $2,882.89 available for grants.

For the committee.

E. W. MORLEY, *Chairman.*

REPORT OF THE DIRECTORS OF THE BENJAMIN APTHORP GOULD FUND.

The directors of the Benjamin Apthorp Gould fund of the National Academy of Sciences have the honor to report that on April 1, 1919, the total income balance of the Gould fund was $7,028.46. Of this amount $1,773.46 is cash, and $5,255 is invested in interest-bearing securities.

Since April 1, 1919, a grant of $500 has been made to Benjamin Boss for the support of the Astronomical Journal.

F. R. MOULTON, *Chairman.*
E. E. BARNARD.
R. S. WOODWARD.

REPORT OF THE DIRECTORS OF THE WOLCOTT GIBBS FUND.

The directors of the Wolcott Gibbs fund for chemical research have the honor to report to the National Academy of Sciences that only one application for an award was received in the past year, and that this was for so large a sum that it could not be considered.

Prof. R. L. Datta, University College of Sciences, Calcutta, grant No. 8, reports that in spite of hindrance from the war he has procured organic chemicals to the value of three-quarters of the grant, and that these have enabled him to carry on work described in two papers now ready for publication in the journal of the American Chemical Society: "Iodination by means of nitrogen iodide and replacement of iodine by nitro groups," by R. L. Datta and J. Lahire. This paper contains a careful study of the two reactions, including the description of seven new compounds. "The replacement of sulphuric groups of chlorine and the preparation of organic chloro derivatives," by R. L. Datta and H. K. Miller. This paper contains a careful study of this reaction.

No reports have been received from Prof. W. B. Harkins, 4 and 7, or from Prof. G. P. Baxter, 6.

The unexpended income of the fund amounts to $622.76, of which $500 has been invested temporarily in Liberty bonds.

C. L. JACKSON, *Chairman.*
EDGAR F. SMITH.
T. W. RICHARDS.

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REPORT OF THE COMMITTEE ON THE MURRAY FUND.

The total amount of income available from this fund, according to the treasurer, is $916.91. Of this $516.91 is cash on hand, and the remaining $400 is invested in Liberty bonds.

The committee duly reported their recommendation in regard to the award of the medal which was approved by the council, and will be carried out at the dinner on April 29, 1919.

WM. H. DALL, *Chairman.*

REPORT OF THE COMMITTEE ON THE MARCELLUS HARTLEY FUND.

(No report was presented, owing to the recent death of the chairman, Dr. George F. Becker.)

REPORT OF THE COMMITTEE ON THE MARSH FUND.

On behalf of the committee of the Marsh fund I beg leave to report as follows:

The total capital Apr. 1, 1919, is	$19,500.00
Cash	375.47
Liberty bonds	150.00
Accrued income to be added May 1, 1919, about	227.00

By the addition of $500 from balance and income the capital is to be raised to $20,000 February 1, 1920.

Grant No. 1. Dr. John M. Clarke, Albany, N. Y.: Mutualism, Symbiosis, and Dependent Life among Animals of Geologic Time. In view of the difficulty of completing this investigation under war conditions Dr. Clarke was authorized to make use of part of this grant for clerical work in the preparation for the Academy of the James Hall biography. Dr. Clarke reports —

First. The original investigation is progressing favorably. "Study of geological evidences of parasitism and dependence has proceeded as opportunity permitted. Surveys and selections have been made of the material in several of the larger museums. Special collecting has been done, a good degree of careful preparation made of the material and a considerable number of enlarged stereo photographs made."

Second. "The Hall memoir, which has involved the reading and extraction of 10,000 letters and many other records, is now approaching conclusion, having been brought up to the year 1880."

Grant No. 2. M. Ferdinand Canu, Versailles, France, Early Tertiary Bryozoa of North America. This grant was to further the completion of investigations in progress in cooperation with Dr. R. S. Bassler, of the United States National Museum, who reports—

"This work is now in press as Bulletin 106 of the United States National Museum, consisting of 162 pages of plates and a correspondingly large number of text figures and pages of text. With this assistance we have also completed a study on 'Early Tertiary Cyclostomatous Bryozoa,' which, when printed, will amount to about 100 pages of text and 30 to 40 plates."

The Marsh fund committee recommends the appropriation of $200 to Prof. Roy L. Moodie, of the University of Illinois College of Medicine, Congress and Honore Streets, Chicago, Ill., for Studies in Paleopathology for the purpose of contributing to the history of medicine and attempting to determine what part, if any, disease has played in the extinction of races.

For the committee,

E. H. MOORE, *Chairman.*

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REPORT OF THE COMMITTEE ON THE ELLIOT PRIZE.

Your committee on the award of the Elliot prize for the year 1918 has carefully considered the works which have been submitted to it, and it is unanimously agreed that the Elliot prize for the year 1918 should be awarded to C. William Beebe, curator of birds, New York Zoological Park, for his work, Monograph of the Pheasants.

In making this award consideration has been given the fact that this monograph was for six years in course of preparation and that it involved a two years' journey to the homes of all the pheasants of the East, also that it includes observations on environment and habits of great originality and novelty, as well as a survey of the types of pheasants in the principal museums of Europe. The author displays both genius and originality in his interpretations. It is, therefore, in the judgment of the committee, the best model of what a zoological monograph should be.

Very respectfully,

HENRY FAIRFIELD OSBORN,
President of the American Museum of Natural History.
FREDERIC A. LUCAS,
Director of the American Museum of Natural History.
CHARLES D. WALCOTT,
Secretary of the Smithsonian Institution.

REPORT OF THE EDITORIAL BOARD OF THE PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

The editorial board reports as follows regarding its activities during the past year:

Volume 4 of the Proceedings has been completed and the numbers of volume 5 are being regularly issued each month.

The articles in volume 4 of the Proceedings may be summarized as follows: Mathematics, 9; astronomy, 11; physics and engineering, 25; chemistry, 5; geology and paleontology, including mineralogy and petrology, 9; botany, 3 (see also genetics); zoology, including general biology, 12 (see also genetics); genetics, 6; physiology and pathology, 10; anthropology and psychology, 1; a total of 91 articles. The division of these articles between members of the Academy and nonmembers is 39 and 52, respectively.

The list of institutions which have contributed three or more articles is as follows: Carnegie Institution, 15, divided as follows: Solar observatory, 7; nutrition laboratory, 4; geophysical laboratory, 1; marine biology, 2; station for experimental evolution, 1. Harvard University, 15; Brown University, 7; University of Illinois, 5; Bermuda Biological Station for Research, 4; University of California, 4; University of Chicago, 4; University of Pennsylvania, 4.

On April 28, 1919, the editorial board held its annual meeting, the following members being present: Messrs. Pearl, Wilson, Day, Hale, Clarke, Jennings, Lusk, Mayor, Millikan, A. A. Noyes, W. A. Noyes, Thorndike, and Wheeler. In regard to the general editorial policy of the Proceedings, it was held to be desirable to make the Proceedings, in so far as possible, a publication of permanent original, scientific value, in which duplication of publication should be avoided so far as was consistent with the general policy which has prevailed in the Proceedings throughout its existence of publishing short articles embodying a brief statement of the results of important researches which were eventually to be published in detail elsewhere. It was agreed that the rule of the

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Proceedings requiring prior publication should be waived in the case of summaries of an extended series of papers, some (if not all) of which had already appeared elsewhere, provided that the summary was so written as to be of practical use in enforcing the points made in individual papers and in attracting the attention of workers in related fields, thus making the summary in the Proceedings a real contribution to the subject.

It was agreed in general to adhere to the present policy of the Proceedings in regard to having the bulk of its contents made up of numerous short articles of first-class quality, falling in general under the six-page limit. It was thought desirable, however, to continue the policy of accepting longer articles under special circumstances, 12 to 15 pages being regarded as a proper maximum length for such articles. It was agreed that the managing editor and the chairman of the board should have all reasonable freedom in exercising their judgment on the administration of policy as to length of articles in particular cases.

A special joint committee of the editorial board of the Proceedings on the one hand, and the National Research Council on the other hand, met and considered the general question of the future relations of the National Research Council and the Proceedings. The special committee was constituted as follows: For the editorial board, the chairman, the managing editor, and Dr. Day; for the National Research Council, Drs. Hale, Merriam, and Yerkes. The general policy worked out by this joint committee was agreed to by the editorial board. It was in effect this, that the Proceedings of the National Academy of Sciences should become in a broader sense than had been true in the past, representative of the activities of the National Research Council, as well as of the National Academy. It was understood that the National Research Council should offer to the Proceedings as official communications of the Research Council of the National Academy such material (intended for publication as bulletins of the council) as the council considered to be of permanent scientific value in the Proceedings. It was felt that in view of the proposed enlargement of the scope of the Proceedings to represent the activities of the National Research Council that some changes in the typography of the Proceedings might be desirable and it was agreed that changes looking to the improvement of the Proceedings in this regard would be inaugurated as soon as agreement on the matter had been reached between the conferees from the two interested bodies.

Although no formal report can be made on the matter at this time, the editorial board is in possession of information which leads it to hope that the financial support of the Proceedings will be more adequately provided for in the near future. In this event the editorial board expects to inaugurate, with the approval of the council of the Academy, certain changes in details of policy which will be in the direction of more liberal arrangements between the Proceedings and its contributors, particularly in the matter of providing a certain number of free reprints to authors. The wisdom of such policy has always been clear to the editorial board, but the simple fact of lack of available funds in the past has made it impossible for the board to carry out its wishes in this matter.

Respectfully submitted.

RAYMOND PEARL, *Chairman.*

The following organization of the National Research Council was presented and adopted as a whole, with power of amendment vested

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in the council of the National Academy of Sciences, and the council of the Academy was authorized to represent the National Academy of Sciences in all its dealings with the National Research Council.

ORGANIZATION OF THE NATIONAL RESEARCH COUNCIL.

[Adopted Feb. 11, 1919, by the Council of the National Academy of Sciences.]

PREAMBLE.

The National Academy of Sciences, under the authority conferred upon it by its charter, enacted by Congress, and approved by President Lincoln on March 3, 1863, and pursuant to the request expressed in an Executive order made by President Wilson on May 11, 1918, hereto appended, adopts the following permanent organization for the National Research Council, to replace the temporary organization under which it has operated heretofore.

ARTICLE I.—PURPOSE.

It shall be the purpose of the National Research Council to promote research in the mathematical, physical, and biological sciences, and in the application of these sciences to engineering, agriculture, medicine, and other useful arts, with the object of increasing knowledge, of strengthening the national defense, and of contributing in other ways to the public welfare, as expressed in the Executive order of May 11, 1918.

ARTICLE II.—MEMBERSHIP.

SECTION. 1. The membership of the National Research Council shall be chosen with the view of rendering the council an effective federation of the principal research agencies in the United States concerned with the fields of science and technology named in Article I.

SEC. 2. The council shall consist of—

(1) Representatives of national scientific and technical societies;

(2) Representatives of the Government, as provided in the Executive order;

(3) Representatives of other research organizations and other persons whose aid may advance the objects of the council.

ARTICLE III.—DIVISIONS.

SECTION. 1 The council shall be organized in divisions of two classes: (*a*) Divisions dealing with the more general relations and activities of the council; (*b*) divisions dealing with related branches of science and technology.

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SEC. 2. The initial constitution of the divisions of the council shall be as follows:

(*a*) Divisions of General Relations:

I. Government Division.
II. Division of Foreign Relations.
III. Division of States Relations.
IV. Division of Educational Relations.
V. Division of Industrial Relations.
VI. Research Information Service.

(*b*) Divisions of Science and Technology:

VII. Division of Physical Sciences.
VIII. Division of Engineering.
IX. Division of Chemistry and Chemical Technology.
X. Division of Geology and Geography.
XI. Division of Medical Sciences.
XII. Division of Biology and Agriculture.
XIII. Division of Anthropology and Psychology.

SEC. 3. The number of divisions and the grouping of subjects in Article III, section 2, may be modified by the executive board of the National Research Council.

SEC. 4. The divisions of general relations shall be organized by the executive board of the National Research Council. (Art. IV, sec. 2.)

SEC. 5. To secure the effective federation of the principal research agencies in the United States, provided for in Article II, a majority of the members of each of the divisions of science and technology shall consist of representatives of scientific and technical societies, chosen as provided for in Article V, section 2. The other members of the division shall be nominated by the executive committee of the division, approved by the executive board of the National Research Council, and appointed in accordance with Article V, section 4.

SEC. 6. The divisions of the council, with the approval of the executive board, may establish sections and committees, any of which may include members chosen outside the membership of the council.

ARTICLE IV.—ADMINISTRATION.

SECTION 1. The affairs of each division shall be administered by a chairman, a vice chairman, and an executive committee, of which the chairman and the vice chairman shall be ex officio members, all of whom shall be elected annually by the division and confirmed by the executive board.

SEC. 2. The affairs of the National Research Council shall be administered by an executive board, of which the officers of the council,

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the president and home secretary of the National Academy of Sciences, the president of the American Association for the Advancement of Science, the chairmen and vice chairmen of the divisions of science and technology, and the chairmen of the divisions of general relations shall be ex officio members. The executive board may elect additional members, not to exceed 10 in number, who, if not already members of the National Research Council, shall be appointed thereto, in accordance with Article V, section 4.

SEC. 3. The officers of the National Research Council shall consist of a chairman, one or more vice chairmen, a secretary, and a treasurer, who shall also serve as members and officers of the executive board of the council.

SEC. 4. The officers of the National Research Council, excepting the treasurer, shall be elected annually by the executive board. The treasurer of the National Academy of Sciences shall be ex officio treasurer of the National Research Council.

SEC. 5. The duties of the officers of the council and of the divisions shall be fixed by the executive board.

ARTICLE V.—NOMINATIONS AND APPOINTMENTS.

SECTION 1. Government bureaus, civil and military, to be represented in the Government division, and the scientific and technical societies, to be represented in the divisions of science and technology of the National Research Council, shall be determined by joint action of the Council of the National Academy of Sciences and the executive board of the National Research Council.

SEC. 2. Representatives of scientific and technical societies shall be nominated by the societies, at the request of the executive board, and appointed by the president of the National Academy of Sciences to membership in the council and assigned to one of its divisions.

SEC. 3. The representatives of the Government shall be nominated by the president of the National Academy of Sciences after conference with the secretaries of the departments concerned, and the names of those nominated shall be presented to the President of the United States for designation by him for service with the National Research Council.

SEC. 4. Other members of the council shall be nominated by the executive committees of the divisions, approved by the executive board and appointed by the president of the National Academy of Sciences to membership and assigned to one of the divisions.

SEC. 5. Prior to the first annual meeting of the council following January 1, 1919, all divisions shall be organized by appointment of their members in accordance with Article II and Article V, sections 1 to 4.

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SEC. 6. As far as practicable, one-third of the original representatives of each scientific and technical society and approximately one-third of the other original members of each of the divisions of science and technology shall serve for a term of three years, one-third for a term of two years, and one-third for a term of one year, their respective terms to be determined by lot. Each year thereafter, as the terms of members expire, their successors shall be appointed for a period of three years.

SEC. 7. The Government representatives shall serve for periods of three years, unless they previously retire from the Government office which they represent, in which case their successors shall be appointed for the unexpired term.

SEC. 8. As far as practicable, a similar rotation shall be observed in the appointment of the members of the divisions of general relations.

ARTICLE VI.—MEETINGS.

SECTION 1. The council shall hold one stated meeting, called the annual meeting, in April of each year, in the city of Washington, on a date to be fixed by the executive board. Other meetings of the council shall be held on call of the executive board.

SEC. 2. The executive board and each of the divisions shall hold an annual meeting, at which officers shall be elected, at the time and place of the annual meeting of the council, unless otherwise determined by the executive board and such other meetings as may be required for the transaction of business.

SEC. 3. Joint meetings of the executive board of the National Research Council and the council of the National Academy of Sciences shall be held from time to time, to consider special requests from the Government, the selection of organizations to be represented in the National Research Council, and other matters which, in the judgment of the president of the National Academy, require the attention of both bodies.

ARTICLE VII.—PUBLICATIONS AND REPORTS.

SECTION 1. An annual report on the work of the National Research Council shall be presented by the chairman to the National Academy of Sciences, for submission to Congress in connection with the annual report of the president of the Academy.

SEC. 2. Other publications of the National Research Council may include papers, bulletins, reports, and memoirs, which may appear in the Proceedings or Memoirs of the National Academy of Sciences, in the publications of other societies, in scientific and technical journals, or in a separate series of the Research Council.

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RULES.

The following new rules and additions to rules were recommended by the council and approved by the Academy:

RULE II, 6 (NEW).

The treasurer is authorized to act as the treasurer ex officio of the National Research Council.

RULE II, 7 (NEW).

The treasurer shall have the assistance of a salaried and bonded officer, the bursar, who shall be chosen by the finance committee and be directly responsible to the treasurer.

RULE III, 5.

Paragraph 1: Strike out the first 10 words.

Paragraph 2: Strike out entirely.

Paragraph 3: In line 1 strike out the words "program committee" and substitute the words "committee of arrangements."

Paragraph 4: In line 1 strike out the words "local committee" and substitute the words "committee of arrangements."

Paragraph 4: In line 4, after "appointed," strike out the remainder of the paragraph.

So that the rule as amended shall read:

"5. A local committee of five members appointed for each meeting and the home secretary shall together constitute the committee of arrangements, of which the home secretary shall be chairman.

"It shall be the duty of the committee of arrangements to prepare the scientific program for the meetings, and for this purpose it shall be empowered to solicit papers from members or others. It shall also be empowered to ascertain the length of time required for reading papers to be presented at the scientific sessions of the Academy, and when it appears advisable to limit the time to be occupied in their presentation or discussion.

"The committee of arrangements shall meet not less than two months previous to each meeting. It shall prepare the detailed program of each day, and in general shall have charge of all business and scientific arrangements for the meeting for which it is appointed."

RULE VI, 5 (AMENDED).

By inserting "the president of the Academy ex officio" in second line after "of."

The standing committee on finance shall consist of the president of the Academy ex officio, the treasurer ex officio as chairman, and two members to be appointed annually by the president.

That a budget committee on the expenses of the National Academy and the National Research Council, to consist of the president of the Academy, the chairman of the National Research Council, and the treasurer of the National Academy of Sciences and the National Research Council, be appointed and the president of the Academy act as chairman.

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RESIGNATION OF TREASURER.

The following communication from Mr. Whitman Cross, resigning the position of treasurer, which he had held for eight years, was presented and accepted with regret, in view of the valuable services which Mr. Cross had rendered to the Academy:

APRIL 21, 1919.

DR. CHARLES D. WALCOTT,
President National Academy of Sciences,
Smithsonian Institution, Washington, D. C.

MY DEAR DR. WALCOTT: I hereby respectfully tender my resignation as treasurer of the National Academy of Sciences, to take effect on May 1, or as soon thereafter as my successor can qualify. It has been a great pleasure to render to the Academy such service as I could as treasurer during the last eight years. It is now necessary that I should be able to devote myself exclusively to the completion of work which has been in progress for many years in connection with the United States Geological Survey.

With high appreciation of the opportunity for connection with the work of the Academy for so many years, I am,

Very sincerely yours,

WHITMAN CROSS.

ELECTIONS.

The annual elections were held. Mr. C. G. Abbot was unanimously elected home secretary. Mr. F. L. Ransome was unanimously elected treasurer. Messrs. J. J. Carty, H. H. Donaldson, and Raymond Pearl were elected members of the council.

The following new members were elected:

Joseph Barrell, Yale University, New Haven, Conn.

Gary Nathan Calkins, Columbia University, New York.

Heber Doust Curtis, Lick Observatory, California.

Gano Dunn, 43 Exchange Place, New York.

Lawrence Joseph Henderson, Harvard University, Cambridge, Mass.

Reid Hunt, Harvard University, Cambridge, Mass.

Treat Baldwin Johnson, Yale University, New Haven, Conn.

Winthrop John Vanleuven Osterhout, Harvard University, Cambridge, Mass.

Frederick Hanley Seares, Mount Wilson Observatory, Pasadena, Calif.

William Albert Setchell, University of California, Berkeley, Calif.

George Owen Squier, Major General United States Army, Washington, D. C.

Augustus Trowbridge, Princeton University, Princeton, N. J.

Oswald Veblen, Princeton University, Princeton, N. J.

Ernest Julius Wilczynski, University of Chicago, Chicago, Ill.

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Edwin Bidwell Wilson, Massachusetts Institute of Technology, Cambridge, Mass.

The home secretary was requested to transmit the thanks of the Academy to the Signal Corps of the United States Army, the Smithsonian Institution, the Bureau of Standards, and to the Cosmos Club, for the courtesies extended during the meeting.

ANNOUNCEMENT OF MEDALS.

The Academy assembled for dinner at the Wardman Park Inn on the evening of April 29, when announcements of the award of medals were made as follows:

The Agassiz Medal, for research in oceanography, to Albert I, Prince of Monaco.

The Henry Draper Medal, to Charles Fabry, of the University of Marseilles, in recognition of his researches in physics and astronomy, chiefly by means of interferometers.

ACADEMY OF HUMANISTIC SCIENCE.

At a meeting of the council April 28, 1919, Mr. Breasted presented the following statement regarding the purpose and functions of a National Academy of Humanistic Science:

SCOPE, PURPOSE, AND FUNCTIONS OF A NATIONAL ACADEMY OF HUMANISTIC SCIENCE.

Scope.—The prosecution of research in the career and activities of man historically considered.

Chronologically such research would begin with the emergence of man as an implement-fashioning creature in Quaternary times, correlating with the work of the palaeontologist. It would then follow his successive stages of the human career, always with careful study of each habitat, through the rise of civilization in the Near East, and the career of civilized man, ancient, medieval, and modern.

Geographically such research would devote itself primarily though not exclusively to the areas which were the home of the civilizations from which we ourselves have descended, that is Africa and Eurasia; but also America, chiefly post-Columbian America.

Topically, the subjects chiefly included in such research would be archæology, art, philology, literature, history, sociology, economics, and philosophy.

Personally regarded, such research would include only men engaged in applying modern scientific methods of investigation and not solely the creative imagination, as in the case of artists, architects, and writers, who would not be included.

Purpose.—The correlation of all research in the career of man, resulting eventually in the articulation of the course of historic civilization with the evolutionary stages already traceable in the prehuman ages; the recovery of as full an account of man's career as the surviving evidence will permit; and the construction of a

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basis of observed fact for the philosophical consideration of the whole vast synthesis.

Functions.—(1) The mutually helpful association of all the leading scientific men engaged in the researches described. They now have no common organization.

(2) To serve as a nationally representative body of men engaged in humanistic research. At present there exists no such American body able to bring its influence to bear, for example, on such a pressing case as the future control of scientific research in the former Ottoman Empire, which contains the lands where civilization arose.

(3) To serve the same public purpose met by similar organizations in the academies of Europe, for example, the Académie des Inscriptions et Belles-lettres, in France.

(4) The guidance, encouragement, and support of the researches suggested.

JAMES H. BREASTED.

SCIENTIFIC SESSIONS.

MEETING OF APRIL 28–30, 1919.

MONDAY, APRIL 28.

MORNING SESSION.

Alfred G. Mayor: The age of the fringing reef of Tutuila, American Samoa.

Charles D. Walcott: Seaweeds and sponges of the Middle Cambrian.

Robert G. Aitken: The spectra of the visual binary stars.

George E. Hale, F. Ellerman, S. B. Nicholson, and A. H. Joy: The magnetic polarity of sun spots.

Walter S. Adams and A. H. Joy: The motions in space of some stars of high radial velocity.

Walter S. Adams and G. Strömberg: The use of the spectroscopic method for determining the parallaxes of the brighter stars.

Adriaan van Maanen (introduced by George E. Hale): Evidence of stream motion afforded by the faint stars in the Orion nebula.

Graham Lusk and H. V. Atkinson: The production of fat from protein after giving meat in large quantity to a dog.

William S. Halsted: End-to-end anastomosis of the intestine—experimental study.

Robert M. Yerkes (introduced by George E. Hale): Psychological examining in the United States Army.

AFTERNOON SESSION.

Frederick H. Seares (introduced by George E. Hale): Relation between color and luminosity for stars of the same spectral type.

Frederick H. Seares, A. van Maanen, and F. Ellerman (introduced by George E. Hale): Deviations of the sun's general magnetic field from that of a uniformly magnetized sphere.

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W. W. Campbell: The solar corona.

Herbert E. Gregory (introduced by W. M. Davis): Plans for exploration of the Pacific.

Francis G. Benedict, W. R. Miles, and Alice Johnson: The temperature of the human skin.

S. J. Meltzer and M. Wollstein: The influence of degeneration of a vagus nerve upon the development of pneumonia.

Demonstration of war research problems at the National Bureau of Standards.

William Ellery Hale Lecture, by James Henry Breasted, Professor of Egyptology and Oriental History, University of Chicago. Subject: The origin of civilization—From the old stone age to the dawn of civilization.

Reception to members and guests at the United States National Museum, National Gallery of Art.

TUESDAY, APRIL 29.

MORNING SESSION.

Edwin H. Hall: The effect of great pressure on the electric conductivity and thermoelectric properties of metals.

Edwin H. Hall: Comments on the results of Bridgman's experiments.

Charles Lane Poor (introduced by J. S. Ames): Line of position computer.

Irving Langmuir: The arrangement of electrons in atoms and molecules.

Henry F. Osborn: Palaeomastodon, the ancestor of the long-jawed mastodons only.

Henry F. Osborn: Seventeen skeletons of Moropus; probable habits of this animal.

Thomas B. Osborne and Alfred J. Wakeman: The preparation of vitamine-free proteins.

Arthur G. Webster: Tentative results in interior ballistics.

Arthur G. Webster: Tentative results in elastic hysteresis.

Edwin H. Hall: Thermal conduction in metals, from the standpoint of dual electric conduction.

Edwin H. Hall: The thermoelectric equation $P=T\,dV/dT$ once more.

A. O. Leuschner and Sophia H. Levy: Perturbations of minor planets discovered by James C. Watson: (104) Clymene, (106) Dione, (168) Sibylla, (175) Andromache. Read by title.

Arthur G. Webster: The most perfect tuning fork.

Arthur G. Webster: Angle of repose of wet sand.

Edward Kasner: Geometry of the wave equation.

C. G. Abbot: Rotating projectiles from smooth-bore guns (illustrated).

C. G. Abbot: Means for measuring the speed of projectiles in flight (illustrated).

C. G. Abbot: Recent simultaneous measurements of the solar constant of radiation at Mount Wilson, Calif., and Calama, Chile (illustrated).

John C. Merriam: Human remains from the Pleistocene of Rancho La Brea (illustrated).

A. G. Webster (read by title): On the equation of state of powder gases whose specific heats satisfy the law of Mallard and Lechatelier.

William Ellery Hale Lecture, by James Henry Breasted, Professor of Egyptology and Oriental History, University of Chicago. Subject: The origin of civilization—The earliest civilizaton and its transition to Europe.

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WEDNESDAY, APRIL 30.

Joint session National Academy of Sciences with National Research Council.

George E. Hale: The past work and future plans of the National Research Council.

John C. Merriam: The Division of General Relations, Section on Relations with Educational Institutions and State Committees.

R. A. Millikan: The Division of Physics, Mathematics, Astronomy, and Geophysics.

Dayton C. Miller: Pressures and velocities, internal and external, due to the discharge of large guns.

E. W. Washburn: The Division of Chemistry and Chemical Technology.

A. A. Noyes: Nitrate investigations.

Whitman Cross: The Division of Geology and Geography.

R. G. Hussey: The Division of Medicine and Related Sciences.

R. M. Yerkes: Psychology in relation to the war.

C. E. McClung: The Division of Agriculture, Botany, Forestry, Zoology, and Fisheries.

G. H. Clevenger: The Division of Engineering.

REPORT OF THE AUTUMN MEETING.

The autumn meeting of the Academy was held at Yale University, New Haven, Conn., on November 10, 11, and 12, 1919.

Fifty-five members were in attendance, as follows:

Abbot, C. G.
Bailey, L. H.
Benedict, F. G.
Boltwood, B. B.
Bumstead, H. A.
Cannon, W. B.
Cattell, J. McK.
Chittenden, R. H.
Cross, Whitman
Cushing, Harvey
Dana, E. S.
Davenport. C. B.
Davis, W. M.
Day, Arthur L.
Donaldson, H. H.
Elkin, W. L.
Flexner, Simon
Gomberg, Moses
Gooch, F. A.
Hall, E. H.
Harrison, R. G.
Hastings, C. S.
Henderson, L. J.
Howard, L. O.
Jennings, H. S.
Kasner, Edward
Johnson, T. B.
Leuschner, A. O.
Lusk, Graham
Lyman, Theodore
Mayor, A. G.
Meltzer, S. J.
Mendel, L. B.
Mendenhall, C. E.
Millikan, R. A.
Morse, E. S.
Nichols, E. F.
Noyes, A. A.
Osborn, H. F.
Osborne, T. B.
Parker, G. H.
Pearl, Raymond
Prudden, T. M.
Russell, H. N.
Schuchert, Charles
Setchell, W. A.
Squier, G. O.
Stratton, S. W.
Trowbridge, A.
Verrill, A. E.
Walcott, C. D.
Webster, A. G.
White, H. S.
Wilson, Edwin B.
Wood, R. W.

BUSINESS SESSIONS.

The president announced the deaths of W. G. Farlow, elected to membership in the Academy in 1879; Joseph Barrell, elected in 1919; Lord Rayleigh, elected foreign associate in 1898; and Emil Fischer, elected foreign associate in 1904.

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SECTION OF ENGINEERING ESTABLISHED.

The home secretary stated that a Section of Engineering had been established, and that it is now constituted as follows: Messrs. H. L. Abbot, J. J. Carty, Gano Dunn, W. F. Durand, J. R. Freeman, H. M. Howe, F. B. Jewett, G. O. Squier, D. W. Taylor. All members of the Sections of Physics and Chemistry were given an opportunity to remain with the section with which they had been affiliated or to be placed in the Section of Engineering.

AUDITING COMMITTEE.

Messrs. L. O. Howard, C. E. Mendenhall, and David White were appointed to audit the accounts of the treasurer.

EDITORIAL BOARD.

Messrs. J. C. Merriam, Gano Dunn, L. J. Henderson, A. L. Day, and W. J. V. Osterhout were elected members and Mr. Raymond Pearl was reelected chairman of the editorial board of the Proceedings to serve for three years.

The following cable, prepared by the foreign secretary at the request of the president and forwarded to Nature, was read:

The president of the National Academy of Sciences requests me to offer his congratulations to Nature on the occasion of its jubilee. During a period of specialization Nature's extensive survey of the progress of research has stimulated wider vision and larger effort. In spite of repeated discouragement it has urged upon the statesmen of two generations the vital importance of science to the Nation. At a time when the branches of science, no longer isolated, are uniting in common channels, and when governments, once unappreciative, are recognizing the bearing of research on national security and public welfare, we rejoice in Nature's expanding influence and the higher opportunities for service opening to it in a newly ordered world.

THE MARY CLARK THOMPSON GOLD MEDAL.

The president reported that Mrs. Mary Clark Thompson had completed the establishment of a fund amounting to $10,000, the income of which it to be applied to a gold medal of appropriate design to be awarded annually by the Academy for the most important services to geology and palaeontology. The medal is to be known as the Mary Clark Thompson Gold Medal. Mrs. Thompson previously gave an additional $1,000 for the preliminary expenses of dies, etc The following resolution in acknowledgment of this gift was adopted:

That the National Academy of Sciences express to Mrs. Mary Clark Thompson the appreciation of its members, especially those working in the fields of geology and paleontology, for this munificent gift to promote the recognition of research in these subjects.

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AWARDS.

In accordance with the recommendations of the Henry Draper committee, the following grants and award of medal were approved:

1. Four hundred dollars to Prof. S. A. Mitchell, director of the Leander McCormick Observatory, University of Virginia, to complete the purchase of a measuring microscope for use in the photographic determination of stellar parallaxes, on the basis of observations made with the 27-inch refracting telescope. The Academy awarded the sum of $250 from the Draper fund to Dr. Mitchell in 1916 to apply on the purchase of this instrument. The microscope cost $650. The proposed grant of $400 will complete the purchase, in effect making the instrument the property of the Academy, and Prof. Mitchell will devote an equivalent sum, $400, to the other needs of his parallax research.

2. Three hundred dollars to Dr. Joel Stebbins, professor of astronomy in the University of Illinois, to assist in the further development and application of the photoelectric cell photometer.

3. Four hundred dollars to Dr. Frank Schlesinger, director of the Allegheny Observatory, to enable him to test an automatic zenith camera for the determination of terrestrial latitudes with the expectation that the results will be more accurate than any hitherto obtained by other means. It is proposed that this instrument be mounted, at least temporarily, at the International Latitude Observatory, Ukiah, Calif., where the astronomer in charge, Mr. Neubauer, will operate it for a year or two as a labor of love. The grant is needed to install the instrument at Ukiah and to make certain auxiliary apparatus required in its operation.

That the Henry Draper Gold Medal be awarded to Alfred Fowler, F. R. S., professor of astrophysics, Imperial College, South Kensington, London, at the time of the stated meeting in April, 1920, for his researches in celestial and laboratory spectroscopy, which have led to a valuable increase of our knowledge of sun spots, comets, and the stars—especially red stars of Secchi's Type III.

ORGANIZATION OF THE NATIONAL RESEARCH COUNCIL.

[Amended articles of the organization of the National Research Council, approved by the Council of the National Academy of Sciences.]

ARTICLE IV.—ADMINISTRATION.

Section 1. The affairs of each division shall be administered by a chairman, a vice chairman, and an executive committee, of which the chairman and vice chairman shall be ex officio members; ~~all of whom shall be elected annually by the division and confirmed by the executive board.~~ *The officers and executive committee of the Divisions of General Relations shall be appointed by the executive board for such periods as may be determined by the board, except that the foreign secretary of the National Academy of Sciences shall be ex officio chairman of the division of Foreign Relations. The officers and executive committee of each of the Divisions of Science and Technology shall be elected by the division at its annual meeting and confirmed by the executive board.*

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ARTICLE IV.—ADMINISTRATION.

Section 2. The affairs of the National Research Council shall be administered by an executive board, of which the officers of the council, the president and home secretary of the National Academy of Sciences, the president of the American Association for the Advancement of Science, the chairmen and vice chairmen of the Divisions of Science and Technology, and the chairmen of the Divisions of General Relations shall be ex officio members. ~~The executive board may elect additional members not to exceed 10 in number, who, if not already members of the National Research Council, shall be appointed thereto, in accordance with Article V, section 4.~~ *In the absence of the chairman of a Division of General Relations, the vice chairman or other executive officer shall represent him. The Council of the National Academy of Sciences and the executive board of the National Research Council, meeting in joint session, may nominate additional members not to exceed 12 in number, who, if not already members of the National Research Council, shall be appointed thereto, in accordance with Article V, section 4. Chairmen of the National Research Council, upon their retirement, shall continue as members of the executive board for two years beyond the period of their appointment.*

ARTICLE VI.—MEETINGS.

Section 2. The executive board and ~~each of the divisions~~ *the divisions* shall hold ~~an annual meeting~~ *annual meetings,* at which ~~officers shall be elected, at the time and place of the annual meeting of the council, unless otherwise determined by the executive board, and such other meetings as may be required for the transaction of business.~~ *in the case of the Divisions of Science and Technology, officers shall be elected; such other meetings may be called as may be required for the transaction of business. The annual meeting of the executive board shall be held in April in the city of Washington.*

ARTICLE VIII.—AMENDMENTS.

Section 1. Power of amendment of these Articles of Organization shall reside in the Council of the National Academy of Sciences.

KILEAUA VOLCANO INVESTIGATIONS.

DEPARTMENT OF AGRICULTURE,
Washington, January 18, 1919.

Dr. CHARLES D. WALCOTT,
President National Academy of Sciences,
Washington, D. C.

DEAR DR. WALCOTT: May I not request the National Academy of Sciences to give the department the benefit of its advice with reference to scientific questions involved in the conduct of investigations

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in seismology and volcanology to be carried on principally at the Kileaua Volcano, Hawaii, and elsewhere as the circumstances may warrant? The Congress at its last session appropriated $10,000 for this purpose, and it apparently had in mind the transfer to Government support and direction of the investigations now under way at this volcano, under the supervision of Dr. T. A. Jagger, which are supported by the Hawaii Volcano Research Association. The department, through the Weather Bureau, desires to inaugurate the work promptly and efficiently and to secure the best contributions to the science of volcanic and seismic actions that may be possible with the limited appropriation available. If the representatives of the Academy of Sciences designated to consider this problem desire further details relative to the questions involved, the Chief of the Weather Bureau will be very glad to cooperate with them in every feasible way. I shall appreciate it if you will give the matter your early and favorable consideration.

Very truly yours, D. F. HOUSTON, *Secretary.*

JANUARY 20, 1919.

Hon. D. F. HOUSTON,
Secretary of Agriculture,
Washington, D. C.

DEAR MR. HOUSTON: I have your letter of January 18, 1919, requesting the National Academy of Sciences to advise you with reference to scientific questions involved in the conduct of investigations in seismology and volcanology to be carried on at the Kileaua Volcano, Hawaii, and elsewhere. The matter will be taken up at once and will be given full consideration.

Very sincerely yours,

CHAS. D. WALCOTT, *President.*

WASHINGTON, D. C., *February 12, 1919*

Dr. CHARLES D. WALCOTT,
President National Academy of Sciences,
Smithsonian Institution, Washington, D. C.

DEAR SIR: The committee appointed by you to respond to the request of the Secretary of Agriculture for advice as to the conduct by the Weather Bureau of the Kilauea Volcano Observatory and of similar investigations elsewhere, in order to "secure the best contributions to the sciences of volcanic and seismic action that may be possible with the limited appropriation available," met at the Smithsonian Institution on February 3. The chairman had meanwhile secured from the Chief of the Weather Bureau the data essential to an understanding of the existing situation and had held in-

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formal consultation with some members of the committee. After a careful consideration of this material, the committee desires to submit the following preliminary report on one phase of the subject, where prompt action is desirable.

1. *Assumption by the Weather Bureau of the work at the Kilauea Observatory.*—The committee recognizes the importance of the work hitherto accomplished at the Kilauea Observatory under the auspices of the Hawaiian Volcano Research Association and the direction of Dr. T. A. Jaggar, jr. It also recognizes the great importance of maintaining continuity in the observations and records of the observatory. This continuity appears to be endangered and the committee earnestly recommends that the Department of Agriculture, through the Weather Bureau, should immediately take control and provide for the uninterrupted continuance of the present program of observations and records until opportunity has been given for a thorough study of the opportunities for research in volcanism and seismology in this and adjacent regions, and the possible agencies through which a concordant and effective program can be carried out. The agreement already reached between the department and the Hawaiian Volcano Research Association appears to furnish an appropriate basis upon which the Weather Bureau can assume control of the Kilauea Observatory.

2. *The future administration of the work*—The broad request of the Secretary of Agriculture for advice as to the scientific problems involved in the conduct of the work in question, in order to secure the best results possible under the available appropriation by Congress, requires more mature consideration on the part of the committee. It will give careful consideration to this matter and submit its full report as soon as possible.

For the committee:

WHITMAN CROSS, *Chairman.*

FEBRUARY 12, 1919.

Hon. D. F. HOUSTON,
Secretary of Agriculture,
Washington, D. C.

DEAR MR. HOUSTON: Referring again to your letter of January 18, 1919, requesting the National Academy of Sciences to advise you with reference to scientific questions involved in the conduct of investigations in seismology and volcanology to be carried on at the Kileaua Volcano, Hawaii, and elsewhere, I take pleasure in handing you a brief report furnished me by the special committee appointed to consider the question for the Academy, with a recommendation regarding the continuing of the work. You will note

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the committee is going further in the matter and that you will have a full report with recommendations for the future administration of the work.

Very sincerely yours,

CHAS. D. WALCOTT, *President.*

PRESENTATION OF ELLIOT MEDAL.

At the dinner held at the Hotel Taft on November 11 the Daniel Giraud Elliot medal and honorarium was presented to Mr. C. William Beebe, of the American Museum of Natural History, New York, for his work, Monograph of the Pheasants. Dr. Osborn, chairman of the committee on the award of the Elliot medal, outlined briefly the history and purpose of this award, and Mr. Beebe responded, giving a short, interesting talk about his researches on pheasants.

AWARD PUBLIC WELFARE MEDAL.

Immediately following the dinner, President Walcott presented the following recommendation from the council, which was unanimously adopted:

That the medal for Eminence in the Application of Science to the Public Welfare be awarded to Herbert C. Hoover at the annual meeting in April, 1920, for his applications of science in the conservation, selection, and distribution of food.

YALE UNIVERSITY.

The following resolution was unanimously adopted at the close of the business session on November 11:

That the home secretary be requested to transmit the thanks of the Academy to Yale University, President Hadley, the board of governors of the Graduates' Club, and to the members of the Academy forming the local committee for the courtesies extended to the members of the National Academy of Sciences during the autumn meeting of 1919.

SCIENTIFIC SESSIONS.

MEETING OF NOVEMBER 10–12, 1919.

The scientific sessions of the Academy were held in the Osborn Zoological Laboratory, Sachem and Prospect Streets, New Haven.

MONDAY, NOVEMBER 10.

SCIENTIFIC PAPERS.

W. M. Davis: Four cliff islands in the coral seas.

Edward Kasner: Some new theorems in the dynamics of a particle.

Henry Laurens and Henry D. Hooker (by invitation): The relative physiological efficiency of spectral lights of equal radiant energy content.

Richard S. Lull (by invitation): A study in synthetic paleontology.

Yandell Henderson (by invitation): The adjustment to the barometer of the haemato-respiratory functions in man.

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George A. Baitsell (by invitation): Development of connective tissue in the amphibian embryo.

C. G. Abbot: A new method for determining the solar constant of radiation.

Leigh Page (by invitation): A kinematic interpretation of electromagnetism.

Charles B. Davenport and Albert G. Love: Defects found in drafted men.

James B. Murphy (by invitation): The effect of physical agents on the resistance of mice to cancer.

John M. Clarke: Some restorations of extinct vertebrates. The great sponge colonies of the Devonian; their origin, rise, and disappearance.

Henry G. Barbour and J. B. Herrmann (by invitation): On the mechanism of fever reduction by drugs.

Edwin H. Hall: The Thompson effect from the point of view of dual electric conductivity.

TUESDAY, NOVEMBER 11.

SCIENTIFIC PAPERS.

Alois F. Kovarik (by invitation): A statistical method for studying the radiations from radioactive substances and the X rays.

M. C. Winternitz (by invitation): Anatomical changes in the respiratory tract associated with acid insufflation.

Francis G. Blake (by invitation): Experimental pneumonia in monkeys.

R. A. Millikan: The extension of the ultra-violet spectrum. The effect upon an atom of the passage of an alpha ray through it.

Hideyo Noguchi (by invitation): Leptospira icteroides and yellow fever.

H. H. Laughlin (by invitation): Calculating ancestral influence in man.

Frank P. Underhill, James A. Honeij, and L. Jean Bogert (by invitation): Calcium and magnesium metabolism in certain diseases.

Henry Fairfield Osborn and Charles Craig Mook: Reconstruction of the skeleton of the sauropod dinosaur Camarasaurus Cope (Morosaurus Marsh).

William K. Gregory (communicated by H. F. Osborn): Restoration of Camarasaurus and life model.

William Diller Matthew (communicated by H. F. Osborn): Plato's Atlantis in paleogeography. (Read by title.)

Simon Flexner: Lethargic encephalitis and poliomyelitis.

A. G. Mayor: The history of the coral reefs of Tutuila, Samoa. Biographical notice of Dr. Samuel Hubbard Scudder, 1837–1911. (Read by title.)

R. A. Daly (by invitation): Changes of land and ocean levels.

Samuel Randall Detwiler (by invitation): On hyperplasia of nerve centers resulting from excessive peripheral loading.

T. B. Osborne: Concentration of the water soluble vitamine or yeast.

G. P. Clinton (by invitation): The manner of infection of the white pine by the blister rust. With demonstrations at the Connecticut Agricultural Experiment Station.

T. B. Osborne and Lafayette B. Mendel: Certain chemical properties of foods and their relation to nutrition. With demonstrations at the Connecticut Agricultural Experiment Station.

F. Löhnis (introduced by Raymond Pearl): Studies upon the life cycles of the bacteria. (Read by title.)

Edward W. Nelson (introduced by C. D. Walcott): Lower California and its natural resources. (Read by title.)

F. W. Clarke: A recalculation of the atomic weights. (Read by title.)

Edwin R. A. Seligman: Biographical memoir of Richmond Mayo-Smith. (Read by title.)

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R. S. Lull: Biographical memoir of Samuel Wendell Williston. (Read by title.)

Thomas Chowder Chamberlin: Biographical memoir of Charles R. Van Hise. (Read by title.)

Edward S. Morse: Biographical memoir of Charles S. Minot. (Read by title.)

The last three papers of the session were presented in the auditorium of the Connecticut Agricultural Experiment Station.

WEDNESDAY, NOVEMBER 12.

SCIENTIFIC PAPERS.

Raymond Pearl: On the embryological basis of human mortality.

E. W. Brown (by invitation): Jupiter's five attendant planets.

C. C. Little (by invitation): Notes on human sex ratio. (Read by title.)

A. M. Banta (by invitation): Sex intergrades and their peculiar inheritance. (Read by title.)

J. K. Whittemore (by invitation): The starting of a ship under constant power.

Lorande Loss Woodruff (by invitation): Endomixis in relation to selection in paramecia. (Read by title.)

Arthur A. Noyes and Duncan MacInnes: The activities of the ions of largely ionized substances.

Francis G. Benedict: The basal metabolism of boys from 1 to 13 years of age.

DECEASED MEMBERS.

GEORGE FRANCIS ATKINSON.

Prof. George Francis Atkinson, elected a member of the Academy in the spring of 1918, died in Tacoma, Wash., on November 14, 1918, while engaged in an investigation of the basidiomycetes of the Pacific coast region. He was born in Raisinville, Mich., on January 26, 1854. He studied at Olivet College, Mich., and at Cornell University, graduating at Cornell in 1885, and occupied professorial positions thereafter until his death, being zoological professor at the University of North Carolina from 1885 to 1888, professor of both zoology and botany at the University of South Carolina 1888 and 1889, professor of botany and biology at the Alabama Polytechnic Institute, 1889 to 1892, and at Cornell University in botany from 1892, first as assistant professor and from 1896 as professor, and as head of the botanical department; during most of this period he served also as botanist of the Cornell University Agricultural Experiment Station. He was one of the original members of the Botanical Society of America, and president of that society in 1907–8; editorial duties included membership in the advisory committee on the publication of North American Flora by the New York Botani-

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cal Garden and as associate editor of the Botanical Gazette, and he was a delegate to botanical congresses held in Europe in 1905 and 1910.

Prof. Atkinson was a highly successful teacher and he trained many students who are making noteworthy contributions to botanical science, and occupying important positions in educational institutions. His writings, principally botanical, are voluminous and are widely known and appreciated; these include several text-books as well as many articles in journals and in publications of learned societies. His most important original investigations, and those of which he was fondest, were in the basidiomycetes, on which he was engaged at the time of his death.

His first important mycological work was done in connection with plant diseases in the South, where he was particularly successful in tracing the causative organisms and working out their life histories. At the same time he became familiar with a great variety of parasitic fungi, which knowledge served him well during later years while connected with the Cornell Agricultural Experiment Station.

Soon after coming to Cornell he became deeply interested in the larger fleshy and woody fungi, which interest he never entirely lost, although at times it was overshadowed by cytological and plant-breeding investigations. Large collections were made of these groups of fungi in New York, North Carolina, Europe, and elsewhere, accompanied by field notes and handsome photographs, and a book on the edible and poisonous species was prepared and published. Most of his mycological notes and researches, however, were left in manuscript form.

A few years ago, Prof. Atkinson was given an opportunity to complete his studies of the higher fungi and put them in shape for publication, and it is extremely unfortunate that his untimely death prevented this from being accomplished. Although a taxonomist by necessity, he was a morphologist by choice and training, and his researches in the fungi were particularly valuable on this account.

Prof. Atkinson excelled as a teacher of graduate students, and, when all his other work has been forgotten, he will live in the work and in the hearts of the numerous botanical investigators who have been trained in his laboratories. He was an inspiring lecturer, a clear and forceful writer, an energetic and appreciative leader, and a sympathetic and helpful friend. He set the pace; he was keenly interested in the work of his pupils; he was quick to interpret the phenomena observed; he was always ready to help and encourage the struggling student, and to rejoice with him when a new discovery was made or a difficulty overcome.

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JOSEPH BARRELL.

By CHARLES SCHUCHERT, Yale University.

[Taken from Science, n. s. vol. 49, No. 1278, June 27, 1919.]

American geology has lost one of its foremost leaders, one who promised to stand as high as the highest. Prof. Barrell's other colleagues will undoubtedly agree with Prof. T. C. Chamberlin when he says: "We had come to look upon him as one of the most promising leaders in the deeper problems of earth science. We feel that his early departure is a very sad loss to our profession not only, but to the whole group of sciences that center in the earth and its constitution."

Only a few days before his death there came to him the news of the highest honor that can be given to an American scientist—election to the National Academy of Sciences. His election, furthermore, was by a unanimous vote of the academicians present at the April meeting in Washington, and such a vote is rare in the Academy.

Joseph Barrell, the son of a farmer, was born at New Providence, N. J., December 15, 1869, and died of pneumonia and spinal meningitis in New Haven on May 4, 1919. He leaves a wife and four sons. Standing 5 feet 10.5 inches in height, of the blue-eyed Nordic type, with a full head of wavy, light-brown hair, he was spare and slender in build, but characterized by great muscular strength in comparison to body weight. He was of the eighth American generation from the Puritan George Barrell, who migrated from Suffolk, England, and settled at Boston in 1637. This first American Barrell began as a cooper, but most of his descendants have been seagoing people and shipping merchants. The most widely known and wealthiest was Joseph Barrell, of Boston, after whom the subject of our sketch, his great grandson, was named. This Joseph Barrell is said to have "early espoused and firmly maintained the cause of his country," and for a time represented the town of Boston in the State legislature. It was in his splendid home that Gen. George Washington was entertained during his visit to Boston.

Prof. Barrell received the first part of his collegiate education at Lehigh University, taking in due course its B. S., E. M., and M. S. degrees, and in 1916 this institution gave him its doctorate of science. From 1893 to 1897 he was instructor in mining and metallurgy at his alma mater, and then was given leave of absence to go to Yale for graduate studies in geology, taking his Ph. D. degree in 1900. Returning to Lehigh, he was made assistant professor of geology, and for three years taught not only geology but zoology

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as well. In 1903 he was called to Yale as assistant professor of geology and in 1908 promoted to the chair in structural geology. In the geological department at Yale he was a unifying force and a tower of strength. During the summer months from 1893 onward Barrell spent nearly all the time in the field, working at first as an engineer in the coal mines of Pennsylvania, then in the mines of Butte, Mont., devoting one summer to the geology of southern Europe, and later studying widely the geology of the Appalachians and of the New England States.

Prof. Barrell's first publications, in 1899 to 1900, deal with mining, but since 1901 nearly all his work has been in geology. His bibliography has upward of 45 titles, totaling more than 1,500 pages. Several articles remain unpublished, at least two of which it is hoped to print during this year. A more detailed account of his life and work will appear in an autumn number of the American Journal of Science.

Barrell's most important work has to do with the strength of the earth's crust. The series of papers bearing that title examine into "the mechanics of the earth considered as a body under stress, owing to the variation of density and form which mark its outer shell." He was all the more able to handle this most difficult subject because of his thorough training in engineering at Lehigh. His last work along this line will be published this fall. From the manuscript we learn that "The larger features of the earth's surface are sustained in solid flotation, and at some depth the strains due to the unequal elevations largely disappear, the elevations being compensated by variations of density within the crust. In consequence, the subcrustal shell is subjected to but little else than hydrostatic pressure." Isostatic balance is, however, not everywhere in adjustment, but the adjustments are held to be irregular and imperfect in distribution and mostly concentrated in the outer one-hundredth of the earth's radius, with a tendency to progressively disappear with depth. On the other hand, "the outer crust is very strong, capable of supporting individual mountains, limited mountain ranges, and erosion features of corresponding magnitude."

Barrell also did much toward working out the criteria by which the climates, marine deltas, and geographies of the geologic past may be discerned in the sediments or stratified rocks that make up the greater portion of the geologic record. This work brings out especially the importance in earth history of the ancient formations laid down upon the lands by the fresh waters and the wind, in contradistinction to those deposited by the seas and oceans.

The length of geologic time was another problem that deeply interested Barrell. In his Rhythms and the Measurements of Geologic Time, he came to the conclusion that through the rythmic oscil-

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lations of the terrestrial processes which the earth has undergone, its age is many times greater than even geologists in general have imagined—in fact, that it is of the order of about 1,500,000,000 years.

A fourth line of research which occupied Barrell was the origin and genesis of the earth, and here he extended in modified form the Chamberlin-Moulton planetesimal hypothesis, i. e., that the planets and their moons arose out of the sun during a time of induced tidal disruption. Some of his best work was to develop along this line, and an extensive manuscript on The Genesis of the Earth is ready for publication.

Since 1913 Barrell has on a number of occasions taken opportunity to point out that the supposed Mesozoic peneplain of southern New England was in reality "stair-like or terraced in its character, facing the sea, and bore the marks of ultimate control by marine denudation. These terraces (more than five in number) are now dismantled by erosion except in regions favored by the presence of broadly developed resistant rock structures. * * * All are regarded as younger than the Miocene." With this view, he adds, we get "a suggestion of the geological rapidity of completion of an erosion cycle in a region near the sea and of a sequence of diastrophic rhythms there recorded." Here, too, there is considerable manuscript that will be published later on.

Finally the evolutionary problems connected with paleontology claimed his interest, and he has presented evidence to show that fishes probably arose in the early Paleozoic in the fresh waters of the lands, and thence migrated to the seas. Also that lungs developed out of air bladders in water-breathing animals caught in recurrent epochs of semiaridity. Such great environmental changes brought about the necessity for change from a water habitat to seasonal dry ones, and hence "the piscine fauna which endured these conditions came through profoundly changed." The primitive sharks of Silurian time, having no air bladder, "were driven to the seas. The fresh-water fishes which remained were ganoids and dipnoans, fishes with air bladders efficient for the direct use of air." Finally, from cross-opterygian ganoids, under the stimulus of the semiaridity of the Devonian, there emerged the amphibians, able to carry forward their activities as terrestrial animals.

Similarly he held that man was brought to his present high physical and mental state not merely as the "product of time and life" but that he is "peculiarly a child of the earth and is born of her vicissitudes." The changing climates during the Pliocene and Pleistocene, acting upon the vegetation of these times, caused the prevalent forests of Asia, he thinks, to dwindle away, producing "a rigorous natural selection, which transformed an ape, largely

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arboreal and frugivorous in habits, into a powerful, terrestrial, bipedal primate, largely carnivorous in habit, banding together in the struggle for existence, and by that means achieving success in chase and war. The gradual elimination, first of the food of the forests, lastly of the refuge of the trees, through increasing semiaridity, would have been a compelling cause as mandatory as the semiaridity which compelled the emergence of vertebrates from the waters, transforming fishes into amphibians."

GEORGE FERDINAND BECKER.

By Arthur L. Day.

With the death of Dr. George Ferdinand Becker on April 20, 1919, the Geological Society of America loses an ex-president and one of its original fellows. He died at his home in Washington, at the age of 72 years.

Any memorial of Dr. Becker's service to geology or to the society in which he was most active throughout his career, must begin with a sincere tribute of respect and honor to one of the last of that splendid group of pioneer geologists which was brought together by the famous Survey of the Fortieth Parallel, the founders of the United States Geological Survey. Clarence King, the central figure of the group, has long since gone from among us; but his three distinguished collaborators, Emmons, Hague, and Becker, have but lately finished their tasks and left to other hands the great problems which they so courageously mapped out.

Like most of the pioneer thinkers, now unhappily very few in number, Dr. Becker was by necessity the master of several fields of scientific research. He possessed an excellent working knowledge of mathematics, physics, chemistry, and geology, and used all these with the greatest freedom and effectiveness through all of his work. With the possible exception of Gilbert, there was no man of his time in the Washington geological world who possessed greater versatility in discussion or such breadth of view. In consequence of this, no problem was ever brought to his attention, whether in private council or in the more formal atmosphere of the Geological Society, to which he was not at once ready to contribute some fertile suggestion or some novel viewpoint.

It has sometimes been said—and, I think, rightly—that his formal papers, both in oral presentation and in print, lost something of their effectiveness through an assumption that his listeners and readers were equally well equipped in all of these sciences; and it is certainly true that his most important contribution to theoretical geology, if it may be so called (Finite Homogeneous Strain, Flow,

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and Rupture of Rocks, 1893), was twice republished with popular or field illustrations in place of the rigid mathematical demonstration, because the conclusions would not "clinch" in their mathematical form.

That this versatility was strenuously cultivated by him, rather than an accidental product of early studies, is shown by the fact that the scientific man whom of all his contemporaries he most admired was Lord Kelvin, a man always distinguished for extraordinary breadth of view. He by no means always shared Kelvin's conclusions, particularly in his investigation of the age of the earth and kindred subjects, but his admiration for the pertinence and breadth of Kelvin's reasoning was outspoken.

Dr. Becker's death just at the close of the Great War, in which he took the keenest interest throughout, recalls to mind an even more personal quality. He was practically without fear and often expressed the impulse of his heart—namely, that next to being a student of the interior of the earth he would choose to be an Army officer in the field. Dr. Becker visited the Philippines in 1898 with the United States forces under command of Gen. then Maj. J. Franklin Bell and saw a considerable portion of the Philippine insurrection of that year. In Maj. Bell's official report to Maj. Gen. McArthur, commanding the Second Division of the Eighth Army Corps, the following interesting paragraphs occur under date of February 11, 1898:

> I have reserved for the end of this letter mention of the exceedingly gallant and courageous conduct of Prof. George F. Becker, United States geologist, because in accordance with his idea of his duty he insisted on accompanying me into this fight (Galoocan) and remained with the company, much of the time mounted, throughout the entire engagement. He was as cool and collected as if he were pursuing geological investigations in his study, encouraged the men behind whom he was standing, and rendered other valuable services which required him to pass mounted, immediately in rear of the entire line. I am sorry that, not being a soldier, he can not receive the reward which his courage and gallantry has entitled him to.

With but a single interruption of two years (1892–1894) Dr. Becker was a "geologist in charge" or chief of division in the United States Geological Survey from its establishment in 1879 to the time of his death—a period of almost 40 years. In this position, which he preferred to any other which the survey offered, he found opportunity to initiate the many new directions of research with which his name stands inseparably associated, and he was spared much of the dull administrative routine of Washington departmental life which he particularly abhorred. Indeed it may be said of Dr. Becker that the advancement of these various lines of geophysical research was the dominating purpose of his life. Many times during

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the last 20 years I have heard him say, with that intensity of expression so characteristic of him when in conversation upon the subject he loved, that the study of the interior of the earth was the only thing really worth while.

Though born in New York City (Jan. 5, 1847), Dr. Becker's early life was spent in Cambridge, Mass., where his preference for natural science rather than sports brought him early into contact with such men as Benjamin A. Gould, Jeffries Wyman, Benjamin Peirce, the elder Agassiz, and other distinguished contemporaries, and gave directive impulse to his earlier studies. He was graduated from Harvard in 1868 and went abroad at once, taking advanced degrees at Heidelberg in 1869 and at Berlin (Royal School of Mines) in 1871. Neither did he neglect the practical side while abroad, for he was accustomed to speak with some pride of having "begun life" as a "puddler" while still in Germany.

Upon the completion of his education he went to California, partly in pursuit of health, which in early life appears not to have been rugged, and partly from interest in mining and metallurgy, which was his major subject of study while abroad, and became instructor in those subjects at the State university at Berkeley. There he came in contact with Mr. Clarence King, who was then engaged upon the survey of the fortieth parallel.

Mr. King's strong and inspiring personality, aided perhaps by the personal influence of his two younger associates, Messrs. Emmons and Hague, evidently attracted Dr. Becker strongly, for he became deeply interested in the geological problems developed during that survey, and one of them, the Comstock lode, later became the subject of what is perhaps Dr. Becker's best-known geological memoir (Geology of the Comstock Lode and Washoe District, 1882).

In 1879 when Mr. King was invited by Congress to organize the United States Survey and to become its first director, Dr. Becker was among the first called to Mr. King's side, and here we encounter almost immediately the pioneer quality of Dr. Becker's mind. Notwithstanding the utilitarian demands of the times and the purposes (then utilitarian also) of the survey—namely, to discover and record the mineral resources along the line of the newly opened transcontinental railroad (Union Pacific) and adjacent territory—we find Dr. Becker seeking out two physicists (Dr. Carl Barus and Dr. William Hallock) to be his assistants and initiating the first of the geophysical studies which thereafter became his chief interest. The details of his plan as conceived at that time are nowhere formulated, but he evidently had as an immediate purpose a study of the origin and growth of ore bodies; and, I think, even at the outset he had already in his mind a systematic physical and chemical study of the

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formation of igneous rocks. At all events, the first publications to issue from the laboratory soon after established in one of the towers of the Smithsonian Institution had to do with the physical instruments, if they may be thus collectively described, necessary to such a task. I refer to the development of apparatus for the measurement of the high temperatures involved and of a trustworthy scale in which to express and compare them, of appropriate means for determining and expressing rigidity, viscosity, and other determinative qualities.

The program was evidently directed to a quantitative study of igneous rocks, but did not then reach so far. Nearly 10 years were consumed in the preparation of the weapons for the attack, which, from any viewpoint, whether physical or geological, was at that time a herculean task. Then the political upheaval of 1892 intervened to put an end to the undertaking through the familiar Washington method—the discontinuance of appropriations.

In consequence of this Dr. Becker returned perforce to a routine of survey work, being occupied mainly with the location and development of the mineral resources of the country.

Notwithstanding the fact that he had enjoyed a rare training for just this kind of activity and had opportunity to work in a region of altogether exceptional interest (California to Colorado), the task failed to hold his interest, and he reverted constantly to the necessity for a strict and more comprehensive application of physical law and method to all genetic problems of geology.

In the "Finite Homogeneous Strain, Flow, and Rupture of Igneous Rocks" (1893), which is, perhaps, the finest product of Dr. Becker's analytical genius, we recognize a splendid attempt to define and formulate in precise terms some of the relations in the science of "rock mechanics." This was a magnificent task of pioneer quality and of extraordinary difficulty, but was not immediately fruitful because clothed in somewhat abstruse mathematical form. The paper is destined to exert a considerable influence upon future geological thought (geodynamics).

His papers on schistosity and slaty cleavage were severely criticised, but in many instances his critics failed completely to understand the rigorous methods which he developed for dealing with these rather abstruse problems. His paper on the age of the earth was severely criticised by Barrell. Dr. Becker apparently had no intention of replying to Barrell, although the discovery just before his death of large quantities of helium in natural gas served, I believe, to convince him that his estimate of the age of the earth was not seriously in error.

In 1900 Dr. Becker was able to reestablish his (geophysical) laboratory with the writer as his assistant. The work was resumed

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substantially where Barus and Hallock had left it in 1892, but with the advantage of more appliances, and proceeded with less interference. The first paper appeared in 1904 (The Isomorphism and Thermal Properties of the Feldspars), and contains an introduction written by Dr. Becker in which the purpose and progress of his thought in this direction is briefly but clearly set forth.

In this year also the Carnegie Institution of Washington came to the aid of the undertaking and increased both its scope (to include chemistry) and its resources. In 1907 a separate and more appropriate laboratory building was provided by the same institution, and here he carried out (in collaboration with Mr. Van Orstrand) the experimental work on schistosity, elasticity, and diffusion, which occupied the closing years of his life. The major portion of the results of this later activity is still unpublished.

He had outlined several papers, such as "Elastic after effect," "Notes pertaining to the probability integral," "Applications of capillarity to oil problems," "Treatise on geophysics."

It is greatly to be regretted that the paper on "Elastic after effect" was not published during Dr. Becker's lifetime. It represents a vast amount of painstaking experimental work by Mr. Van Orstrand and his associates using the most refined methods known to quantitative physics, and offers, I think, more elaborate as well as more comprehensive data on elastic after effect than have been obtained hitherto by any investigator. It is obviously unfair, not to say inexcusably presumptuous, to forecast the results of the unpublished work of another, but I can not forbear directing attention to this paper when it may appear because of the value of the data in throwing light upon the vexing subject of the fundamental definition of "solid" and "liquid," and the possibility of placing a boundary between these two states of matter which shall be theoretically sound. The classical definitions of these states of matter were conceived at a period when elastic deformation was much less precisely measurable than now, when the phenomena of plasticity formed a terra incognita, and when the study of the thermal relations between these two states had not been extended to such inert substances as the silicates. The consequent confusion in our conception of these states, according as they happened to be viewed from the mechanical or thermal standpoint, was a problem which interested Dr. Becker profoundly, and one to which he devoted himself most assiduously during several of the later years of his life.

Dr. Becker enjoyed a wide acquaintance and received many honors both at the hands of his colleagues and of foreign learned bodies. He was elected to the National Academy of Sciences in 1901; also the presidency of the Geological Society of America in 1914.

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In thought and manner Dr. Becker was a true pioneer, absolutely fearless, impatient of limitations, quick to get at the heart of a problem, direct and vigorous in its prosecution, and with untiring spirit, even under the strain of protracted illness, which clouded the closing years of his life.

MAXIME BÔCHER.

[From Science, n. s., Vol. XLVIII, No. 1248, pp. 534–535.]

Maxime Bôcher was born in Boston on August 28, 1867. His father, Ferdinand Bôcher, came to this country from France at the age of 15. His mother was Caroline Little, of Boston, a descendant of Thomas Little, who came to Plymouth in the early days of the colony and in 1633 married Anne Warren, the daughter of Richard Warren, who came in the *Mayflower*. Ferdinand Bôcher was the first professor of modern languages at the Massachusetts Institute of Technology; he was called to Harvard shortly after Mr. Eliot became president. Thus Maxime grew up under the shadow of the college, attending various schools in Boston and Cambridge; but it was chiefly by the stimulating influence of his parents, he tells us in the vita of his dissertation, that his interest in science was awakened.

He graduated at the Cambridge Latin School in 1883 and took the bachelor's degree at Harvard in 1888. Then followed three years of study at Gottingen, where he received the degree of doctor of philosophy in 1891, and at the same time the prize offered in mathematics by the philosophical faculty of the university. From 1891 till his death, which occurred at his home on September 12, he was a member of the department of mathematics. He married Miss Marie Niemann, of Gottingen, in 1891. His wife and three children, Helen, Esther, and Frederick, survive him.

He came to Gottingen at a time when Felix Klein was probably the most inspiring teacher of mathematics in the whole world. Breadth and accuracy of scientific knowledge and a true sense of proportion, combined with extraordinary powers of presentation, were characteristics of this great leader, whose scientific productivity had already secured for him high standing among mathematicians.

It was from this environment that Bôcher came to Harvard to take up the profession of mathematics. His skill as an expositor in the classroom, before a scientific audience, and on the printed page shone out from the beginning of his career, but the originality of his mind saved him from ever becoming a mere expositor. As a lecturer he was preeminent among American mathematicians.

It is not difficult in science to find important problems which can not be solved, or unimportant ones which can be. Bôcher was successful in discovering subjects on which the advanced student could work with a reasonable prospect of securing results of value. He

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did not foster research by excessive praise, and his pupils sometimes felt that he was unappreciative. But a scientific contribution of real merit never failed to secure his attention, and he had infinite patience in helping the student who was really making progress to develop his ideas, to see that which was new in its true perspective, and to put his results into clear and accurate language.

As a scientist Bôcher was highly critical. It was, however, the constructive work called for when criticism has exposed errors or disclosed deficiencies, not the destruction with which an unimaginative mind is content, that to him was the important thing. He had extraordinary powers of judgment, both within the domain of pure science, and in things relating to the policies of institutions. His judgment of men, too, was accurate. For these reasons he was unusually well qualified to take a leading part in the affairs of the American Mathematical Society, which came into existence at the beginning of his scientific career. He became its president, and he served with marked success on the editorial board of its Transactions. He also contributed in no small measure toward helping the university to build up a strong department of mathematics.

The decade in which Bôcher's career as a university teacher began was marked by an awakening of the science of mathematics in the country. His scientific contributions were of a distinctively high order, and their volume was not small. He early took a stand among the foremost investigators of the country, and his work met with generous appreciation abroad. On invitation, he delivered an address at the St. Louis congress in 1904 and a lecture at the Fifth International Congress of Mathematicians at Cambridge, England, in 1912, and he was exchange professor at Paris in 1913–14.

His life was lived within the academic walls, and while he took keen interest in current events of the world about him, his contact with men outside of university circles was not broad, and his judgment of them sometimes severe. But when opportunity presented itself to help in time of trouble, he was quick to respond. He sought relaxation from scientific labor in literature, philosophy, and music, rather than in social gatherings.

Those who stood nearest him will remember him best for the singleness of his purpose, the constancy of his effort, and the greatness of his ideals.

WILLIAM GILSON FARLOW.

By F. O. B.

[Nature, Aug. 28, 1919, No. 2600, vol. 103, p. 509.]

Among the leading botanists of America the name of Prof. Farlow, whose death was announced in Nature for June 26, stood out, by seniority, by personal influence, and by scientific attainment. Prof.

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Farlow died on June 3, after an illness of three weeks. He was born in Boston, December 17, 1844, and graduated from Harvard College in the class of 1866, attaining the degree of A. M. in 1869, and of M. D. in 1870. Doubtless he was one of those who followed the wise advice of Asa Gray: "Graduate in medicine; you never know how it will come in useful afterwards."

After graduation, Farlow came to Europe, and pursued his botanical studies in Strassburg. The old French Academie had been replaced shortly after the conclusion of the peace of 1871 by a German university, staffed by professors carefully selected for their eminence. De Bary, an Alsatian by birth, was the professor of botany. The study of fungi was a speciality of his laboratory, which was carried on in the cramped rooms of the old academie. There no doubt the foundations were securely laid for that special study of fungi which Farlow pursued throughout his life. His most notable work at that time was, however, on the ferns; for he was the first to describe the direct origin of the sporophyte from the prothallus by vegetative outgrowth without the ordinary sexual fusion. This phenomenon of "apogamy," though familiar enough to all students now, was in 1874 the first notable digression from the regular alternation described by Hofmeister. Ten years elapsed before the observation of "apospory" by Druery. The discovery of these two cognate innovations has given a fresh impetus to inquiry into the nature of alternation, though alternation itself still remains an unsolved enigma.

After his return to America Farlow was for a time assistant to Prof. Asa Gray; but in 1874 he was appointed assistant professor in Harvard, and in 1879 he received the title of professor cryptogamic botany, an appointment which he held for a period of 40 years. His position became gradually stronger as years passed by, and there was probably among the botanists of America none whose opinion was held in greater esteem than his, while his published work touched a much wider circle than that in his own country.

In America Farlow was a pioneer in cryptogamic botany. His work was largely floristic and systematic. But experimental work was also conducted in his laboratory, and a school was founded, of which a brilliant example is seen in Prof. Roland Thaxter, the monographer of the Laboulbeniaceae.

Personally Farlow was of small build, active, and most vivacious, with a constant ripple of quiet humor, a capital raconteur, and a charming host. In 1900 he married Miss Lilian Horsford. Together they made their house at Harvard, and their country home at Chocorua in the White Mountains of New Hampshire, places of happy memory to those who were fortunate enough to be their guests. Keenly alive to the duties and aspirations of the Allies, they both worked hard for the cause during the war.

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Farlow was the recipient of many honors, being LL. D. of Harvard (1896), of Glasgow (1901), and of Wisconsin (1904), and Ph. D. of Upsala (1907). He was a member of the National Academy of Sciences and of the American Philosophical Society, and was president of the American Association for the Advancement of Science in 1906. He was foreign fellow of the Linnean Society of London (1892) and of the Academy of Sciences of Paris, as well as many other scientific bodies in his own country and abroad. For the first 20 years of its existence he was coeditor of the Annals of Botany. Personally he was well known in this country by reason of repeated visits, and was heartily appreciated both for his social and his scientific qualities.

EDWARD CHARLES PICKERING.

By HENRY NORRIS RUSSELL, Princeton University Observatory.

[From Science, Feb. 14, 1919.]

At the death of Edward C. Pickering American science has lost one of its most distinguished figures, one of the most noteworthy contributors to its progress during the past 40 years, and one of its most inspiring and influential leaders. A full account of his long and active career would demand far more space for its presentation and time for its preparation than are at the moment available; only the main events and achievements of an exceptionally productive life can be touched upon in these few words of appreciation.

Born in Boston in 1846, of an old New England family, and a graduate of Harvard of the class of 1865, after two years as instructor in mathematics, he became professor of physics at the Massachusetts Institute of Technology, where he established the first laboratory in America in which students were instructed by actual contact with physical instruments and measurements. Upon the death of Prof. Winlock, the youngest physicist was called, in 1877, at the age of 31, to the directorship of the Harvard College Observatory, which he held for nearly 42 years, continuing the tradition of the institution, all of whose directors have died in office.

At this time most observatories were devoting themselves mainly to the old "astronomy of position"—the determination of the apparent positions of the stars and other heavenly bodies upon the celestial sphere, and of those constants of nature which can be derived from such observations—and the "new astronomy" (now better known as astrophysics) was in its infancy.

It is characteristic of Pickering that he realized at once in what direction the greatest opportunities lay and set to work to employ the full resources of the observatory in fundamentally important

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work. Harvard had always been sympathetically inclined toward the newer developments of astronomical science, and considerable photometric work had been done under Bond and Winlock; but when the new director began to devote the main portion of his own time and that of the 15-inch telescope (then one of the greatest in the country) to photometric researches, considerable criticism was aroused. "Why," said these critics, "should observations with the meridian circle and micrometer, which yield results accurate almost to one part in a million, be neglected in favor of measures in which differences of 5 or even 10 per cent habitually occur? Can such inaccurate observations be of any value in an exact science?"

Undaunted by these cavils, he continued in his chosen course—with what abundant reason the nearly 80 volumes of the Harvard Annals which appeared during his directorate may testify. The "old astronomy" was not neglected—in fact, 20 years' time was spent by several members of the staff in preparing each of the two Harvard zones of the Astronomische Gesellschaft's scheme of international cooperation in star cataloguing—but the astrophysical work accomplished under Pickering's directorship, and bearing the marks of his genius, is of incomparably greater volume and importance. He was a pioneer in several fields, in each of which he has had many followers.

He was never contented with the unthinking adoption of the methods and instruments of investigation which he found in use, but was always designing new ones with a view to increasing the accuracy of observation and above all, to obtaining rapidity without sacrificing accuracy. In the latter particular he was indeed a master. He possessed a genius for organization which would undoubtedly have brought him both wealth and fame in the world of business, but he preferred to devote these talents to the service of science and because of them enjoyed work of a sort which most other men would have regarded as drudgery. He once said to the writer, "I like to undertake large pieces of routine work." In the great masses of such work done under his direction the principles of "scientific management" were fully applied. All that could be done by assistants of moderate capacity was left to them, and the whole working time of the experienced specialists was devoted to such parts of the work as they alone could do. To extend the study to the stars of the Southern Hemisphere, a station was established at Arequipa, Peru, in 1890, and has been actively maintained ever since, and another has more recently been set up in the island of Jamaica.

The results of these carefully reasoned plans have been so extensive that only the principal features can be mentioned here, leaving a host of minor but highly interesting investigations undescribed.

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In visual photometry Pickering started almost de novo, devising new measuring instruments with which observations of all the accuracy necessary for his purpose could be made with great rapidity, notably the meridian photometers, with which the brightness of stars is measured as they cross the meridian by comparison with some circumpolar star which is always available as a standard. With these instruments more than 45,000 stars have been observed at Cambridge and Arequipa, and the resulting system of visual stellar magnitudes has been generally adopted as an international standard. When to these observations, most of which were made by Pickering himself, are added his numerous measures upon variable stars, satellites, and other objects, the whole number of photometric settings which he personally made rises to the amazing total of more than a million and a half.

He was also a pioneer in stellar photography, and especially in the use of the doublet lenses, which combine great light grasp with a wide angle of field, and can, with an exposure of an hour or two, record on a single plate the positions and magnitudes of a number of stars which may run into the hundreds of thousands. The Harvard equipment includes instruments of this type ranging from the 24-inch Bruce telescope at Arequipa and the 16-inch Metcalf instrument at Cambridge to the little lenses of 1-inch aperture which are used to photograph as large a portion of the visible heavens as possible on every clear night. The plates are developed, indexed, and filed in the great Harvard photographic library, which its creator described as "a library of 250,000 volumes, every one unique, and with but a handful of readers to work in it." The very magnitude of the mass of information stored in this vast collection makes it impossible to extract it all; but whenever an object of unusual interest is discovered, it is only necessary to refer to the Harvard plates to find out just where and how bright it was on some three or four hundred dates during the last 30 years. Among the most notable examples of this may be mentioned the recognition of images of the asteroid Eros upon plates taken two and four years before its discovery, and the recent tracing of the history of the brilliant new star Aquila through an interval of 30 years, up to the very day before the great outburst.

The third principal field of work is in stellar spectroscopy. Pickering led again in the photography of stellar spectra with the objective prism and in the more precise classification of stellar spectra which this made possible. Assisted financially by the liberal aid of the Henry Draper Memorial, he and his very distinguished assistants, Mrs. Fleming and Miss Cannon, studied these spectra, devised the empirical classification of the original Draper Catalogue,

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and improved upon this by omitting some of the original classes and rearranging others, until the resulting classification proved so convenient, and so remarkably representative of the actual facts, that it was adopted without a dissenting voice by the International Union for Solar Research as a universal standard. The fact which was first brought out by this investigation and served as the basis of the final classification that the spectra of almost all the stars fall into a single sequence, along which each type grades almost imperceptibly into the next, is now recognized as the very foundation of modern astro physics, and the progress of discovery serves steadily to emphasize the importance of classification according to spectral type in the most diverse problems of sidereal astronomy. In this field, too, the Harvard work is of imposing extent, culminating the spectra of about 215,000 stars, classified by Miss Cannon. Prof. Pickering took the liveliest interest in this monumental work and in the admirably arranged plans for its production; and it is cause for gratification that the first volume saw the light while he was alive to enjoy it.

One other series of investigations that should not be passed over deals with photographic photometry. This was one of the chief interests of his later years, and an increasing part of the work of the observatory was devoted to it. The establishment of a standard system of photographic magnitudes proved a difficult and intricate problem, but again the results are of primary importance, for the color of a star, which is best measured by the difference between its visual and photographic magnitudes, proves to be almost as important as its spectral type, to which it is very intimately related. Here again the principal work of observation was done by others—Miss Leavitt, Prof. Baily, and Prof. King—but the unifying guidance was Pickering's. Closely related to this is the discovery of variable stars, which, previously largely a matter of chance, was reduced to a system, whether by the comparison of plates of the same field taken at different times or by means of certain spectral peculiarities. The new methods were so successful that the number of variable stars discovered at Harvard within a few years was three times as great as that of all those detected by all the astronomers of the world during the previous history of the science.

Finally, and by no means least, should be recorded his deep interest in and support of cooperation between the whole fraternity of astronomers, whether in this country or abroad. There was hardly an organization for the furtherance of any specific astronomical aim, such as the committee on the "Carte du Ciel" or the Solar Union, in which he did not take an active part, and his counsel and advice were always of weight.

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But equally influential, though less conspicuous, was his ever generous aid to individual investigators, to whom he was continually transmitting invaluable material from the treasures under his charge, sometimes observations already made, but unpublished, and again data concerning stars which had been put upon his observing lists for that especial purpose. His abiding willingness to use his powerful influence to aid other astronomers in obtaining instruments for the expansion of their researches, or funds to provide assistance in the reduction and publication of their observations, is known to all.

It may be pardonable to speak of one or two instances. In conversation, referring to the Metcalf telescope, for which he had found the funds to purchase the glass disks for the lens, and provide the mounting, while the figuring of the lens was done, as a labor of love and in his spare time, by the distinguished amateur whose name it bears, "I felt as if a great artist had said to me, 'If you will buy the canvas and the brushes and paint, I will paint you a picture.'"

If a more personal allusion may be excused, it may be recorded that, shortly after the writer's first interview with Prof. Pickering (during which he had described his first serious astronomical work. on stellar parallax), a letter arrived from Harvard, saying in substance, "I think that it would be useful to determine the magnitudes and spectra of all your stars. If you will send me a list of them we will have them observed and send you the results." This involved the photometric and spectroscopic observation of some 300 stars (the photometric settings being made by Prof. Pickering himself) and was offered as an unsolicited contribution to the work of a young and unknown instructor!

The Harvard Observatory never admitted graduate students of the ordinary sort; and doctoral theses are absent from the long list of its publications. But, under Pickering, it was an educational center of the first rank, and its pupils were not the immature students, but the working astronomers of the country. Who among us has not gone to Harvard, enjoyed the delightful hospitality and finished courtesy of the director, and returned, loaded down with data for investigations new or old, and inspired by his experience with new enthusiasm alike for the magnificent researches of the great observatory, and for his own humbler work!

Such a career deserved unusual recognition and received it in a merited degree. Almost all the honors of the scientific world fell to his lot, and the list of these three distinctions is too long to detail here. But those who knew him will mourn less the disappearance of the distinguished leader of science than the loss of a warm and loyal friend, one of the kindliest and most generous of men.

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WALLACE CLEMENT WARE SABINE.

By EDWIN H. HALL, C. N. GREENOUGH, and P. W. BRIDGMAN, Committee.

[From Science, n. s., Vol. XLIX, No. 1267, pp. 347–360.]

Our colleague, Wallace Clement Ware Sabine, was born in Richwood, Ohio, June 13, 1868. Four racial strains were joined in him, for each of his four names represents some family of his ancestors, one Scotch, one Dutch, one English, one French. The Sabines, of Huguenot stock, came to Ohio from New England in the early part of the nineteenth century. The Wares, his mother's family, of English Quaker antecedents, came there about the same time, probably from New Jersey. Of his father's father, John Fletcher Sabine, the son of a circuit preacher, we are told:

> He was of such gentle disposition that in manhood he renounced the stern faith of his father and came to believe that "all men would be saved." * * * He died at the age of 89, with mind as vigorous and clear as in youth, with a remarkably retentive memory. His wife was Euphemia Clement, a gentle, industrious, reliable woman. Hylas Sabine was their oldest son.

Of his mother's father, Jacob Reed Ware, it is written:

> He was one of the early, ardent abolitionists and lived on the most direct line from southern slavery to freedom in Canada. * * * Untiring of body, alert of mind, and exceedingly strong of purpose, he lived in perfect health, with such simple habits that at the age of 98, without disease, he fell asleep. J. R. Ware married Almira Wallace, a woman of force and uprightness. Anna Ware was their first daughter.

To those who knew Sabine well this brief family history is deeply significant. Gentleness, courtesy, rectitude, untiring energy, fixity of purpose that was like the polarity of a magnet, all these traits we found in him. It is interesting and impressive to see how the individualism and stern conscience that made his ancestors on the one side Protestants in France and on the other side Quakers in England found expression in him, under changed intellectual conditions. He was of the very stuff of which martyrs are made; in fact, he died a martyr to his sense of duty, but, with an austerity of morals and a capacity for devotion which none of his conspicuously religious forefathers could have surpassed, he held aloof, silently, but absolutely, from all public profession of religious creed, and he took small part in religious observances.

As a child he was allowed to develop without forcing, but such was the natural vigor of his mind that he gained the degree of A. B. at Ohio State University at the age of 18. He is said not to have specialized in his college studies, but he had in Prof. T. C. Mendenhall an inspiring teacher of physics, and his early interest in scientific

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matters is shown by the fact that he attended a meeting of the American Association for the Advancement of Science held in Philadelphia in 1884, when he was 16 years old. On leaving Ohio State University in 1886 he came to Harvard as a graduate student in mathematics and physics, and he received the Harvard A. M. in 1888. From 1887 to 1889 he held a Morgan fellowship, but in the latter year he became an assistant in physics. Rather early in his Harvard residence he was taken by Prof. Trowbridge as partner in a photographic study of the oscillating electric discharge, and he showed a remarkable aptitude for work of this kind, requiring high experimental skill, yet he never became a candidate for the Ph. D. Absorption in the work of teaching prevented him for several years from engaging deeply in further work of research. He spent his energy and his talents in building up courses of laboratory work, designing and making apparatus for instruction, and in every way practicing with devotion the profession of a teacher. It is not too much to say that, for the 15 years preceding his taking the duties of a deanship, he was the most effective member of the department of physics in giving inspiration and guidance to individual students of promise. This was due in part to his sympathetic willingness to give help, and to spend much time in giving help, though others were not lacking in this quality. It was perhaps due mainly to the fact that, while he was no more deeply versed than others in the profundities of physics and mathematics, he had a peculiarly clear vision for the right kind of experimental problem and for the best way of attacking it, and his students instinctively, it may be, perceived this.

For a long time he seemed to be content to remain in comparative obscurity, while directing others into paths of conspicuous achievement. He was made assistant professor of physics in 1895, after six years of teaching, in which he had published little or nothing descriptive of research. This was partly because he had a most severe standard for what a research paper should be; it should describe some piece of work so well done that no one would ever have to investigate this particular matter again. To this standard he held true, with the result that his published papers were remarkably few and remarkably significant.

One might have expected him, when he found time for research, to take up some problem in light, for that seemed to be his chief field of interest; but accident, and a sense of duty, turned him to a different quarter. The Fogg Art Museum, on its completion in 1897, proved to have an auditorium that was monumental in its acoustic badness, and President Eliot, who had formed a high opinion of Sabine's qualities, called upon him to find a remedy, as a practical service to the university. With this warrant for diverting some of

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his energy from teaching, Sabine entered upon an investigation which proved to be his most conspicuous scientific work. Though he was dealing with a new structure, he was attacking a practical problem as old as the institution of public buildings. It had never been solved before in any thoroughgoing manner. He did solve it, and he did this not by virtue of any extraordinary resources given by modern science. He did it in such a way as to show that it might have been done by a man like him centuries before. Not only did he cure the defect of the particular room that first engaged his attention; he went on with his study till he could tell in advance what the acoustic qualities of a projected auditorium would be; and his visible instruments in all this achievement were organ pipes, common fabrics and materials, and the unaided human ear.

Was it, then, so easy and simple a thing to do? Did he merely happen to find the solution of a difficulty thousands of years old? No. He succeeded by reason of a combination of qualities, among which were unending patience and untiring energy. He must work in the small hours of the night, when other men had ceased from their noisy labors and when street cars were infrequent; he must, for certain ends, work only in the summer, when windows could be kept open; in the early summer, before the crickets began their nightly din. He must work with the most scrupulous regard for conditions that to another might seem trivial. He once threw away the observations of months because be had failed to record the clothes he wore while at his work. Such was the difficulty of his undertaking, on the mere physical side, and such the rigor of his devotion to it. We say of such a man, "It is a pity he died so young." If he had taken care of himself, had been regular in his meals and in his hours of sleep, he would have had a long as well as a useful life. Yes; but the things he undertook to do, and did do, can not be done by a man who must be regular at his meals and regular in his hours of sleep.

The establishment of a Graduate School of Applied Science, in place of the undergraduate Lawrence Scientific School which had existed at Harvard for a long time, was the result of a movement led by Sabine in 1906. It was doubtless his hope, from the start of his connection with this revolutionary action, to make the Harvard School of Applied Science one of the highest and best in the world; but concerning the wisdom of making it distinctively and only a graduate school, he was not altogether positive, in spite of the fact that the suggestion to make it such is attributed to him. In fact, the decision of the faculty to approve this policy was arrived at in a curiously casual way. Argument against it was made at a faculty meeting, and nobody seemed to be confidently in favor of it. Sabine told a colleague the next day that just before the vote was taken

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he tried to get the president's attention, to move a postponement of the question. He did not succeed, the vote was taken, and the policy was launched.

Sabine took the deanship of the Scientific School reluctantly, at the urgent request of President Eliot, but he threw himself into the duties of the office with characteristic energy, devotion, and elevation of ideals. It was his ambition to make the school as good as any school of applied science anywhere, and he strove for that end.

Whether the history and fate of the school would have been notably different if it had included undergraduate programs of study is, fortunately, a question we need not discuss. For it is now possible to undertake the experiment of building up at Harvard a school of applied science second to none in its higher reaches but standing on a base of directed undergraduate work done within Harvard walls. In this undertaking we can have no better ideals than those which Sabine's deanship kept always before us.

When this deanship ended he returned gladly to the work of teaching and research, and but for the war he would probably have had before him a long career of growing usefulness and fame, and would have lived to a vigorous old age, according to the habit of his ancestors. But from that fiery furnace into which other men were drawn by millions he could not hold himself back. He would have felt recreant if he had escaped unscathed. Going to France in 1916 with the intention of giving a course of lectures as exchange professor at the Sorbonne in the fall, he engaged during the summer in the work of conducting tuberculous patients from the French hospitals to Switzerland, an enterprise undertaken by the Rockefeller Foundation. Overworking in this, he was attacked during the fall by a disease which nearly ended his life and compelled the postponement of his Sorbonne lectures. When he was able to be moved he went back to Switzerland, this time as a patient; but he gained strength, studying French constantly meanwhile, and in the spring of 1917 gave his lectures on architectural acoustics in Paris. These ended, he went through some months of extreme activity in the technical-science service of the allied Governments. Returning to America in the late fall, he went on with similar work in Washington, and elsewhere, coming to Cambridge for his lectures every week, eating and sleeping when and where he could, always too busy for the surgical operation which his physical condition demanded. He refused military rank, declaring, with that severity of judgment which sometimes verged upon intolerance, that the uniform should be worn only by those who were subject to the dangers and labors of the front. But he risked his life constantly, and at last fatally, in the service of the country and the university.

We have known in him a rare spirit, and we reverence his memory.

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EMIL FISCHER.

By H. E. A.

[Nature, July 31, 1919, No. 2596, vol. 103, pp. 430, 431.]

The death of Emil Fischer will be deeply regretted throughout the world of chemists; his achievements alone suffice to belie the attempts too frequently made of late years, during the war, by speakers in no proper way conversant with the subject, to belittle German scientific performance and originality. No act is so dangerous as that of underrating the intelligence of an enemy; but this we persistently did in the past, notwithstanding the warnings that were given by those few who were alive to the facts; and this we are boastfully doing at the present, before we have made any effective progress in overcoming the difficulties by which we were hampered in the past and while we are still almost leaderless and unorganized.

Emil Fischer was one of Germany's great academic experts—a man who was listened to and used by his government and supported in every necessary way; he was simply worshipped by industry. We can but envy the position he enjoyed. Our Government has still no use for the expert; indeed, the board of trade has officially declined, only recently, to give academic chemical science any voice in connection with so ultra-chemical a subject as the dyestuff industry—an industry which is simply the laboratory writ large; and the industrial worker still too often scoffs at the academic worker instead of treating him as his boon companion—perhaps sometimes with show of reason, as the latter is apt to get on stilts.

When the present writer first met Fischer in Strasburg in January, 1882, he all but fell in love with him on the spot. A Rhinelander, tall, well-built and well-dressed, with eyes of wonderful brightness, and manners of most engaging frankness and courtesy, Fischer had scarcely any of the attributes of the pedagogue, although, as years went on and he grew in importance, his impatience with those who ventured to question his opinion became more obvious—but no German can escape from this. If not the prototype of a new academic genus, Fischer was certainly a mutant of the original German species. A far greater chemist than his predecessor, Hofmann, he lacked Hofmann's diplomatic qualities and love of influence; and though he filled his office with dignity and distinction, he in no way courted publicity; indeed, for the most part he lived the austere life of the recluse, spending his time, other than that given to necessary official duties, entirely either in his laboratory or in his study. He systematically overworked himself, and there is little doubts that his frequent complaints of his health—of his Magen particularly—were largely conditioned by overwork. No chemist has secured success to a greater extent through constantly enforced intellectual

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effort and the determination, having once conceived an object, to win through. He was a striking contrast, in this respect, to his wonderfully alert contemporary, Victor Meyer, in whom the faculty of immediately seeing and seizing an opportunity was perhaps more highly developed, though he had neither the fixity of purpose nor the patience of his colleague; but Meyer was a Jew, hence the difference. The two men made parallel discoveries, almost at the same time, the one by developing the use of phenylhydrazine, the other that of hydroxylamine, as differential analytical agents; but phenylhydroxylamine became the Rosetta stone with the aid of which Fischer unlocked the story of the sugars and justified Pasteur's prediction that life is an asymmetric process.

It is impossible to overrate the value of the three great series of investigations which are inseparably linked with Fischer's name, as, by his work on the sugars, on the proteins, and on uric derivatives (each an inquiry of unparalleled magnitude and importance), he made biology, on the chemical side, a science.

Fischer appears to have continued to exercise his academic activity throughout the period of hostilities, as communications bearing his name have been published at frequent intervals. It is difficult to imagine that he could have taken any part in the hellish work of war. The loss of such a man at such a time is greatly to be deplored, as he would probably have been one of the few to exercise an ameliorating influence. He died at the comparatively early age of 67.

Fischer received the Davy medal from the Royal Society in 1890 and was elected a foreign member of the society in 1899. He was awarded the Nobel prize in 1902. He had many competent English and American workers among his students, who rendered him no slight assistance. His laboratory has been one of the limited number in which, of late years, experience of real value, both technical and moral, could be gained; few men have set so high an example to their students and no one was more mindful in spirit of his countryman, Kekulé's saying, "Nur keine unreifen Früchte." He would recommend no one who was not sufficiently trained. Many are now seeking entry into practice here who are not only undertrained but also unaware of their ignorance; herein lies our danger—we have yet to attach real meaning to the term "chemist" and to follow Fischer's example. As representative of the genus in its most highly developed modern form, he is to be placed at the apex.

From the time of Liebig onward English students have visited German laboratories and these have undoubtedly afforded them valuable opportunities. But the Germans have also been gainers thereby and they have yet to realize what they lose by our with-

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drawal. The change of circumstances will be to our advantage in many ways. The object of higher training should be to promote originality and individuality, but, instead of being trained on individualistic lines, of late years students in Germany have been lead to worship authority rather than to be free thinkers.

A more serious consequence of the constant emigration of our students to German laboratories, however, was the effect this had in preventing the development of higher education in our own schools; until recently it rendered the systematic prosecution of chemical inquiry and the formation of schools of research in this country almost impossible. Our most capable workers were constantly withdrawn from us just as they were about to become valuable instruments—we were allowed to sharpen pencils but not to use them. In fact, we have allowed the Germans to monopolize not only the dyestuff industry but also the higher academic industry; and not only have our best students been encouraged to leave us but we have also done our utmost to sterilize the intellects of the remainder by a cast-iron system of examinations. The 1851 commissioners, unfortunately, favored this policy; indeed, at one time they almost forced their chemical scholars to go to Germany. As there was no interchange, we were left without helpers. The protests made as to the impolicy of the course were of no avail. We were told, in no halting terms, that we sought to keep the students at home to serve as our assistants, yet the Germans were allowed to use them to their ends. In the eyes of our officials what was improper here was permissible abroad. Fortunately, during the past decade or two, we have been successful in gradually stemming the tide of emigration and our higher instruction has been developed apace, though hitherto it has never been otherwise than starved.

LORD RAYLEIGH.

By H. A. R.

[From American Journal of Science, vol. 48, No. 285, pp. 249–250.]

Lord Rayleigh, the celebrated English physicist, died on June 30 at his home, Terling Place, Witham, Essex.

John William Strutt, third Baron Rayleigh, was born on November 12, 1842. He was graduated from Cambridge as senior wrangler in 1865 and for a time was a fellow of Trinity College. In 1879 he succeeded Clerk Maxwell as Cavendish professor of experimental physics at Cambridge and continued to occupy this chair until 1884, when he resigned. From 1887 to 1905 he was professor of natural philosophy in the Royal Institution, a post which required him to give only a few public lectures each year. He was secretary of the Royal Society from 1887 to 1896, and president from 1905 to 1908.

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In the latter year he became chancellor of the University of Cambridge, and continued to hold this office until his death. He is succeeded in the title by his eldest son, the Hon. Robert John Strutt, who has followed in his father's footsteps as a physicist and has been for some years professor of physics in the Imperial College of Science, South Kensington.

Lord Rayleigh's first scientific paper was published in 1869, and for 50 years there has been no interruption in the steady flow of his contributions to science. There are altogether about 400 papers and, as J. J. Thomson says, "Not one of these is commonplace, and there is not one which does not raise the level of our knowledge of its subject"; even in the last year of his life there appeared to be no falling off in his work in either quantity or quality. He was equally at home in mathematical and experimental investigations, and in both his work was marked by extraordinary simplicity and directness of method. Most of his experimental work was done in a private laboratory in one of the wings of his country house, and no physicist who visited it could fail to be astonished at the primitive equipment which was sufficient in Rayleigh's hands for work of the highest importance. A similar impression was made upon one when he discussed work in which he was at the time engaged; it seemed so straighforward and natural that it was hard to realize it might not have been equally done by anybody.

The achievement by which Lord Rayleigh is best known to the general public is the discovery of argon, in the later stages of which he had the assistance of Sir William Ramsay. His treatise on The Theory of Sound has had no serious rival since its first publication in 1877; in all the laboratories and experimental stations which worked on the antisubmarine problem during the war this work was constantly resorted to when difficulties were great, and it usually supplied either the complete solution or at least a suggestion as to the best mode of procedure.

Lord Rayleigh received all the honors and rewards which could fall to the lot of a man of science. He served on many boards and committees in the public interest and with great advantage to his country. He was the first president of the advisory committee for aeronautics, a body whose work before and during the war has been the chief factor in giving to Great Britain the preeminence in theoretical and applied aeronautics which she holds to-day.

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FOURTH ANNUAL REPORT OF THE NATIONAL RESEARCH COUNCIL.

INTRODUCTION.

The broad general lines of the permanent organization of the National Research Council were determined shortly after the armistice, and a specific program was adopted by the Council of the National Academy of Sciences on February 11, 1919. The work of the year has in large measure been necessarily monopolized by the effort to round out and complete this program and put it into actual operation. The organization in its present form with the appropriate personnel is presented as Appendix A of this report.

An appreciable part of the war work conducted by the council or under its auspices did not terminate in 1918, but was continued for longer or shorter intervals, and some of the committees are still operative, having been assimilated into the peace-time organization. This is peculiarly true of those committees whose work is most closely related to industrial problems, many of which are quite as significant for times of peace as for war. Certain metallurgical researches in progress under the division of engineering are cases in point.

The year has seen the completion of the organization of each of the 13 divisions included in the present scheme. It has been a somewhat slow process to secure the cooperation of all the scientific and technical societies and other organizations, including many departments of the Federal Government, which under the plan were entitled to elect representatives to the several divisions. This has, however, been finally accomplished in a satisfactory manner.

On June 30, 1919, the National Research Council passed out from under its more direct relations to the National Government through the Council of National Defense. This transition was accomplished without friction, and although there are still some financial accountings not yet completed, all are in the way of a speedy settlement, and we may look forward to an early conclusion of all our more direct responsibilities to the Government. Through the Government division, however, as well as through the division of foreign relations, and by reason of our desire to serve the national interests wherever possible, we shall continue our contacts with the Government, in the hope that they will lose nothing of their practical value because of the change in their external forms.

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GIFTS TO THE COUNCIL.

With the cessation of the relations described in the previous paragraph, the council was obliged to look to purely private resources for its financial maintenance. The treasurer's report herewith attached presents in detail the fiscal arrangements of the council, but it is appropriate to mention more explicitly our obligations to the many individuals and agencies which have made our work possible.

By an action of March 28, 1919, the Carnegie Corporation of New York expressed its readiness to appropriate in due time $5,000,000, to be placed at the disposal of the National Academy of Sciences for the purposes of the Academy and the National Research Council, provided that a suitable site should be secured from other sources, and that a satisfactory plan for a building to serve the purposes of the two beneficiary organizations should be presented. A block of land in the neighborhood of the Lincoln Memorial was agreed upon as a proper site, and estimates were secured of the probable cost; i. e., $150,000. A committee, consisting of Messrs. Hale, Millikan, and Angell, set about to obtain the necessary funds by securing, if possible, 15 individuals of national standing who would contribute $10,000 apiece. By reason of various unforeseen circumstances the price of the land proved to be $185,010.21, and it was consequently necessary to raise a considerably larger sum of money than had been originally anticipated. Persistent effort, however, finally crowned this undertaking with success. The obligation of the council to the generous friends who assisted us can not be overestimated, inasmuch as they made possible the permanent establishment of the council on a firm financial basis. A public acknowledgment will be made at a later date.

As the result of the joint action of the council of the National Academy of Sciences and the National Research Council Mr. Bertram G. Goodhue, of New York, was asked to prepare sketches for a building, and on November 28 the Carnegie Corporation of New York, having previously accepted as satisfactory the evidence of purchase of the site mentioned, authorized a committee of its own to accept the sketches submitted by Mr. Goodhue or to authorize any modifications judged to be necessary, and therewith recognized the conditions of their action of March 28, 1919, as having been met, thus assuring the very generous endowment agreed to under that action.

In addition to these provisions for the permanent support of the council, the Carnegie Corporation contributed, exclusive of $60,000 unexpended from the previous year, $100,000 for the fiscal year from July 1, 1919, to June 30, 1920. The corporation has also voted a sum of $170,000 for the fiscal year July 1, 1920, to June 30, 1921. The executive board of the National Research Council has formally expressed its appreciation for these generous gifts, but it is a peculiar

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pleasure to dwell in this connection upon the unquestioned national service which the Carnegie Corporation is thus rendering in establishing in perpetuity a thoroughly democratic organization which is in a position to mobilize our national scientific resources for the most unselfish service. It is quite impossible to measure the good results which are sure to accrue as the years go by from this wise and generous investment. It is a privilege which all the members of the council appreciate, to have had some part in laying the foundations of this enduring edifice.

A considerable number of other gifts have come to the council during the current year which deserve grateful recognition.

First may be mentioned the appropriation on April 9, 1919, by the Rockefeller Foundation, under the accompanying resolutions, of $500,000 to provide for research fellowships in physics and chemistry for five years.

Resolved, That the sum of $50,000 (R. F. 2395) be, and it is hereby, appropriated, of which so much as may be necessary shall be paid to the National Research Council during the year 1919 for the maintenance of a system of national research fellowships in physics and chemistry under the direction of the research board of that council and in general conformity with the plans outlined in letter of application.

Resolved, That the Rockefeller Foundation pledge itself to appropriate to the National Research Council for the maintenance of a system of national research fellowships in physics and chemistry such additional sums for use in succeeding years as shall make available for expenditure during the period from May 1, 1919, to June 30, 1925, a total sum not to exceed $500,000, it being understood that the appropriation for any one year shall be for not more than $100,000 plus any unexpended balances from appropriations for previous years.

This action brought to a head plans which had been under consideration between representatives of the National Academy of Sciences and the National Research Council, on the one hand, and the Rockefeller Foundation, on the other, designed to further fundamental investigations in physics and chemistry.

As a part of this plan, there was established on March 11, 1919, a research fellowship board, selected to administer such funds when secured. The personnel of this board is as follows: Henry A. Bumstead, Simon Flexner (chairman), George E. Hale, Elmer P. Kohler, Robert A. Millikan, Arthur A. Noyes, and ex officio, C. E. Mendenhall and W. D. Bancroft.

Under date of June 16, 1919, the Rockefeller Foundation, in response to a request by the Division of Physical Sciences, took the following action:

Resolved, That the sum of $20,000 be, and it is hereby, appropriated to the National Research Council for the Division of Physical Sciences, of which so much as may be necessary shall be used to defray the necessary traveling and other expenses involved in conferences of the subcomittees of that division during the year 1919.

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Inasmuch as the success of the plan upon which the National Research Council is founded depends in very large measure upon the frequency with which the members of its several divisions and committees can assemble for conference, this gift is peculiarly acceptable, and its results will be watched with the greatest interest. It may come to pass that after the work of the divisions is firmly established there will be less need for these frequent conferences, but at the outset, when specific projects are being matured, they are highly essential. As the members of the divisions and committees are geographically widely scattered, and few of them could afford to bear the burden of their own expenses in attending such conferences, the need of funds for this purpose is quite obvious. The council has used its own funds as far as practicable for the same purposes, but its resources have thus far been quite inadequate to permit as frequent meetings of its personnel as would be desirable.

For both of these generous contributions to the work of the council the Rockefeller Foundation has our very sincere appreciation.

Under date of February 27, 1919, the General Education Board adopted the following resolution:

Resolved, That the executive committee be authorized in its discretion to appropriate a sum not exceeding $25,000 for the purpose of financing the preparation of mental measurements of school children, provided the undertaking is organized and conducted by a competent and responsible agency.

Under date of March 1, 1919, Mr. Abraham Flexner, secretary of the General Education Board, communicated this action to Dr. Yerkes, with a statement that in the opinion of the officers of the General Education Board the terms of this resolution would be met provided the National Research Council officially made application for the appropriation, the work to be done by Dr. Yerkes, Dr. Terman, and their associates. Accordingly, the chairman of the council, under date of March 11, wrote to the officials of the General Education Board requesting this appropriation, and on March 13 Mr. Abraham Flexner replied, stating that the appropriation would be transmitted to the National Research Council under such conditions as might be mutually convenient.

On September 5, 1919, the General Education Board adopted the following resolution:

Resolved, That, upon the request of the National Research Council under date of August 12, 1919, the sum of $10,000, or so much thereof as may be needed, be, and it hereby is, appropriated to the National Research Council, to enable the Division of Educational Relations to conduct certain educational investigations outlined in Dr. Angell's memorandum during the year ending September 30, 1920.

The memorandum referred to outlined the desirability of a survey of research conditions in educational institutions throughout the

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country. This survey will be conducted not from the point of view of discovering possible subjects of criticism, but to ascertain in what ways the council can be of most service in stimulating and promoting research work and in the training of research personnel in these institutions.

Both of these gifts of the General Education Board were acknowledged by the executive board of the council in appropriate resolutions, but it should be added that the council has been greatly gratified not only by the fact of these generous contributions to its work, but perhaps equally by the confidence these gifts and the others previously mentioned evince in the essential value and practicability of its undertakings. Confidence begets confidence, and the reputation of the Rockefeller Foundation and the General Education Board for keen discrimination in their selection of enterprises to assist has been, and will continue to be, a source of great strength to the council in its effort to secure public support.

As the result of a frank presentation of the current financial problems of the council by Dr. Vernon Kellogg, the directors of the Commonwealth Fund announced on December 15, in a letter from Dr. Max Farrand, general director, an appropriation of $2,000 a month for six months beginning January 1, 1920, or so much thereof as might be necessary for the running expenses of the National Research Council up to July 1, 1920.

Owing to many unforeseeable difficulties connected with the transition of the council from its wartime organization to its present form, the expenses of the council threatened seriously to outrun for the fiscal year its available assets. There was never any question of the encountering of an outright deficit, but there was very great danger that certain important features of the work of the council would have to be discontinued for the last six months of the year in order to avoid such a deficit. The extremely generous action of the directors of the Commonwealth Fund has prevented this grave catastrophe, whose consequences for the future usefulness of the council it would be difficult to overestimate. From this time forward, it will be entirely possible to have the annual budget of the council adequately provide all essential expenditures, and the accounting system now in force will prevent any recurrence of the conditions which necessarily arose during the war, when emergencies requiring instant action often involved disregard of all ordinary principles of expenditure. So long as the Government service required, such emergency actions were undoubtedly justified, and occasionally quite inevitable, but they have no place in the procedure of an organization like the National Research Council in times of peace.

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GENERAL POLICIES.

It has been necessary to consider many problems of permanent general policy, to certain of which brief reference may properly be made.

At least two conceptions of the financial functioning of the council are obviously possible. It may, on the one hand, be thought of as an organization which shall achieve its purpose to foster and stimulate scientific research by the accumulation of a large endowment, the income from which might from time to time be allotted to meet the expenses of specific researches. In this case the council would simply become one more among the several extant endowed agencies for the furtherance of enterprises of social importance, with particular emphasis upon those of a scientific and investigatory character. On the other hand, the council may be viewed as an agency for the exercise of the maximum stimulation of research men and research agencies designed to assist in the securing of cooperation among men and organizations capable of carrying on valuable investigations, but under the necessity of seeking special funds from other sources whenever definite financial support may be necessary. Its own resources on this assumption would be devoted solely, or at all events chiefly, to the maintenance of its own administrative machinery.

After mature consideration, the second of these two general policies has been definitely adopted. It at once appears that as a consequence of this policy the council is likely to be a somewhat constant solicitor of financial support for certain of the research undertakings to which its divisions may commit themselves. In view of the large number of individuals connected with the council and the considerable number of different divisions, it has been quite essential that there should be an early formulation of the general principles in accordance with which appeals for financial support should be made. The accompanying report of a committee appointed to study this question is herewith attached.

REPORT OF THE COMMITTEE ON GENERAL POLICY AND SOLICITATION OF FUNDS.

In an organization like the National Research Council, the solicitation of funds is a matter of the utmost practical importance and also one involving fundamental questions of policy. To safeguard, so far as possible, the essential interests of the council, your committee presents for your consideration the following analysis of the situation and a formulation of principles of procedure:

1. While it is hoped and believed that the vested funds of the council will support its permanent administrative expenses, it is clear that all definite research enterprises undertaken by the council must be financed by funds specifically secured for such purposes. This means that so long as the council is active, money raising for one purpose or another will be constantly in progress.

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2. At least two general modes of procedure are obviously feasible. There may be (*a*) a central money-raising committee, possibly the present finance committee, to which should be confided responsibility for securing the funds required by each separate project (it would be assumed that such projects had already been approved by the proper central authority, presumably the executive board); or (*b*) separate committees or individuals may be empowered to raise funds for each project approved. Under either plan, there must obviously be some provision for determining priority of claims among possibly competing projects. Such competition might conceivably affect the purely scientific or professional aspects of the projects, as in an overlapping of biological with chemical or medical interests; or it may relate to the soliciting of funds from the same sources, in which case again it would be quite essential to determine priority. Obviously the question regarding the agency through which funds are to be solicited is secondary to this more basic question of determining priority.

3. In any plan which is adopted, due consideration must be given to two opposing factors. On the one hand, no avoidable step should be taken tending to discourage the initiative of the several divisions and their scientific and professional backers. On the other hand, scrupulous care must be exercised to prevent the appearance of competition and lack of organization inside the divisions of the council.

If sole responsibility for the soliciting of funds is accorded to the several divisions, there would be secured the maximum of responsible interest for the furtherance of the policies adopted by the divisions, but on the other hand, there would be prompt and certain conflict of interests in both the directions indicated above. If responsibility for approving the several proposed projects and the suggested methods of financing them be retained by the executive board, or an accredited agent of the board, for example, a committee or the chairman, the more overt conflicts are likely to be avoided, but with unfavorable effects upon the spirit and energy of such divisions as may find their projects temporarily held in abeyance. The plan proposed attempts to avoid the disadvantages of both extremes while retaining so much as is possible of their advantages.

PROPOSED POLICY.

1. Every project requiring financial support must be approved by the division proposing it.

2. Every such project shall be formulated in writing in as much detail as possible and accompanied by an estimate of expense for each of the readily distinguishable items of cost, e. g., salaries, apparatus, clerical expense, travel, etc.

3. Such statements shall be submitted by the chairman of the division concerned to a project committee, together with a statement of the persons, companies, or corporations whose financial support is to be solicited, with suggestions of the amount to be asked from each and designation of the agents proposed to make the approach. The project committee authorized by the executive board shall be composed of the chairman, secretary, and treasurer of the National Research Council.

4. The project committee will, at the earliest possible date, reply to the chairman of the division concerned, approving or disapproving the project or requesting that it be held in abeyance. The division may appeal from any such decision to the executive board at its next monthly meeting.

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5. The project committee shall report to the executive board at each meeting of the board all actions taken during the preceding month, with a full statement of the reasons for the same.

Owing to the intimate relations of Engineering Foundation to the engineering division of the National Research Council, and the possible overlapping of certain of the interests of Engineering Foundation with those of other divisions of the council, it was thought wise to formulate the general relations which should govern the solicitation of funds by these two organizations. There is attached herewith draft of a statement adopted by the two groups to control their policies in this matter:

DECEMBER 20, 1919.

NATIONAL RESEARCH COUNCIL AND ENGINEERING FOUNDATION BOARD AGREEMENT OR UNDERSTANDING CONCERNING POLICY IN SOLICITATION OF FUNDS.

National Research Council and Engineering Foundation Board, each through a special committee, having studied the matter of solicitation for funds, and through their respective chairmen and other representatives having conferred as to possible interferences and confusion to the disadvantage of both organizations which would arise if a policy were not established and respected by them, herein record their mutual understanding and agreement as follows:

In so far as the field of engineering is concerned, National Research Council will in the main seek funds for current support of specific researches.

Engineering Foundation Board will seek funds for endowment, the income of which will be used for the support of research under the terms of its charter.

Engineering Foundation Board will not seek funds for current expenditures in support of specific researches, excepting in fields not being cultivated by National Research Council, and in any case not without previous consultation and arrangement with the council.

National Research Council will keep complete confidential reference records of projects of research for which financial support is to be solicited, including the names of parties to whom appeals are made and their responses.

National Research Council and Engineering Foundation will keep each other informed of actions taken in connection with the solicitation of funds.

From the foregoing, it appears that there should be no conflict, but only mutual support between National Research Council and Engineering Foundation in the solicitation of funds.

NATIONAL RESEARCH COUNCIL,
By JAMES R. ANGELL.
ENGINEERING FOUNDATION BOARD,
By W. F. M. GOSS.

PUBLICATIONS.

Another subject to which much careful study has been given is the publication policy of the council. Without attempting to characterize in detail the grounds upon which the decision of the council was finally based, I submit herewith draft of a report of the publication committee, which will indicate the publication enterprises to which

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the council has committed itself. It is believed to combine at the minimal possible expense the advantages of a system providing for the publication of important scientific papers and reports, not elsewhere finding appropriate media of publication, with the merit of securing a wide circulation of documents which may already have appeared elsewhere, but which warrant circulation among a different constituency from that reached through the channels in which they were originally issued. In the entire matter, two controlling principles have been in view: (1) The publication of such materials as are distinctly pertinent to the purposes of the council as an agency for promoting research, and (2) the circulation of materials designed to familiarize the widest possible public with the purposes and methods of the council, and with scientific contributions themselves possessing wide general interest.

The chairman of the committee on publication reported that as a result of a meeting of that committee with a committee of the editorial board of the proceedings of the National Academy of Sciences, the following agreement was reached:

I. The agreement as to editorial policy herewith entered into between the committee on publication of the National Research Council and the editorial board of the proceedings of the National Academy, hereafter set forth in detail, shall be understood to be binding upon both bodies for the calendar year 1920, and thereafter until notice of change has been given as provided for in paragraph 2.

II. So long as the National Research Council has any relations with the proceedings of the National Academy, written notice of any intended change in policy of publication originating in either of the contracting bodies shall be sent to the chairman of the editorial board of the proceedings and to the chairman of the committee on publication of the National Research Council at least 30 days prior to a regular meeting of the National Academy of Sciences (April or November).

III. For publication in the proceedings of the National Academy of Sciences, which has been designated as the official organ of the National Research Council, the following varieties of material shall be considered acceptable:

(*a*) Minutes of executive board, divisions, special boards, and committees.

(*b*) Scientific reports of individuals, boards, or committees.

(*c*) Research surveys which present an historical résumé and outlook on problems in particular fields of research.

(*d*) Reports of scientific research.

IV. Subject to approval and authorization by the executive board of the National Research Council, that body shall contribute to the financial support of the proceedings in accordance with the following plan:

(*a*) The Research Council shall pay for the space used as previously, but during the calendar year 1920 it is understood that at least 300 pages of space shall be paid for.

(*b*) The National Research Council shall distribute the proceedings of the National Academy of Sciences to such of its members as do not already receive the publication. For all copies thus distributed the Research Council shall pay at the regular subscription rate of $5 per volume.

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RELATIONS BETWEEN TWO MAIN GROUPS OF DIVISIONS.

It has become apparent that the six general divisions of the council sustain somewhat diverse relations to the divisions of science and technology; certainly that they are not homogeneous, as was originally intended. As experience has accumulated, it has in particular become clear that the division originally known as industrial relations and the research information division sustain peculiar relations to the divisions of science and technology. It seems a safe prediction that similar experiences will be repeated in the near future. These facts should not occasion any serious concern, because the organization of the council is reasonably flexible, and it is to be expected that substantial changes may be necessary from time to time. Only in the case of the industrial relations division has it thus far been necessary to take any specific action designed to lessen the practical difficulties encountered. In this instance, three changes have been brought about, two of a purely verbal character and one touching somewhat more intimately the theory of the administration of the division.

It was early remarked that the term "industrial relations," under which the division was originally organized, was susceptible of somewhat serious misunderstanding in that the term too readily suggests concern with the economic and personnel problems of industry. The title was accordingly changed to industrial research, only to have this objected to as seriously confusing to certain of the important interests represented in the engineering division, whose research work, it was insisted, must necessarily be almost wholly in the industrial field. Reluctantly, and with full appreciation of the many objections to the term, the council has officially adopted the title of research extension. These titular changes in and of themselves have not been designed to produce the slightest alteration in the work of the division in promoting research among the industries.

It was the theory of the operation of the division that it should carry on promotional work simply, and that once an industry or a group of industries had adopted a research program, the execution of this should be turned over to one of the divisions of science and technology, or at least that the services of these divisions should be offered to the enterprise in question. Simple as this program is in theory, it appears to present some difficulties in fact in so far as the engineering division in its work with the industries finds it practically essential to carry on much, if not all, of its own promotional work, and there has apparently been undesirable confusion occasioned to certain industrial concerns by the seeming presence of two of our divisions in the industrial field. To minimize these difficulties

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as far as possible, it has been arranged that the research extension division shall act as a service division for the science and technology groups, undertaking to promote their interests among the industries wherever this is desired, and abstaining from work in the engineering field unless its assistance is explicitly requested by the authorities of the engineering division. It should be recognized that the friction which has been developed reflects only upon the wisdom of the original plan. The officers of the research extension division have carried on their work with great energy and success in close accordance with the original formulation of their functions, and such difficulties as have developed have been the inevitable outcome of the failure to anticipate the complexities of the actual situation. It is hoped that the present solution of these perplexities will bring prompt relief.

COUNCIL QUARTERS.

On July 1, 1919, the council was obliged to abandon its old quarters and, as a result of previous negotiations, took over the building at 1201 Sixteenth Street. This location has been from many points of view very satisfactory, but the building is slightly too small for the present needs of the organization, and it may therefore, perhaps, prove to be no serious permanent disadvantage that, by reason of the sale of the building, we shall be obliged to move to other quarters on July 1, 1920.

REPORTS OF DIVISIONS.

A. DIVISIONS OF GENERAL RELATIONS.

I. Government Division.

Charles D. Walcott, *Chairman.*

This division was organized on December 19, 1919. The personnel of the division representing the several Federal departments will be found in Appendix A. An executive committee was appointed, representing the Department of War, the Navy, the Interior, Agriculture, and Commerce.

In view of the very recent organization of the division no definite plans for its work have been as yet adopted, but favorable consideration has been given to suggested activities in which two or more departments of the Government might profitably cooperate. Foods and fuels illustrate problems significant for a considerable number of the Government departments. The executive committee has been requested to study the question of advantageous problems for common work and to report at an early meeting of the division.

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II. Division of Foreign Relations.

George E. Hale, *Chairman.*

The division of foreign relations has held two meetings during the year, one on April 15 for the purpose of making a preliminary survey of the field, and one on December 10 to complete the scheme of organization and begin systematic work. For the organization of the division, see Appendix A.

The functions of the division of foreign relations are:

1. To serve as the agent of the National Research Council in foreign affairs not within the scope of qualified special organizations, and in dealings with the International Research Council which involve the joint interests of two or more international bodies concerned with special branches of science and technology.

2. To promote cooperation in matters of joint interest among the several American national committees or other representatives of international organizations.

3. To inquire into the advisability of initiating new international organizations, and to cooperate with the special American groups interested in their formation.

4. To keep in close touch with the Department of State, and to inform the department of pending international scientific and technical questions in which the Government may be interested.

5. To prepare and publish annually a concise summary of American activities in international scientific and technical organizations.

At the meeting of December 10 reports were presented on the International Research Council, the International Astronomical Union, the International Geodetic and Geophysical Union, the International Union of Pure and Applied Chemistry, the International Electrotechnical Commission, the International Commission on Illumination, the International Standardization of Electric Units, the Exploration of the Pacific, the Institute of International Education, and the question of International Patents. Statements were also made regarding the preliminary steps taken in Brussels (see below) to initiate international unions in mathematics, physics, radiotelegraphy, geology, geography, and biology (with which medicine was classed in the Brussels scheme). Most of these reports have already been published or will soon appear in the Proceedings of the National Academy of Sciences.[1]

[1] Report of the Meetings of the International Research Council and the Affiliated Unions held at Brussels, July 18–28, 1919, by W. W. Campbell, chairman of the American delegates (to appear in the Proc. Nat. Acad. Sci.). The International Research Council and the International Astronomical Union, W. W. Campbell, Publications of the Astronomical Society of the Pacific, October, 1919. Report of the Organization of the International Astronomical Union, W. W. Campbell, chairman of the American section (to appear in Proc. Nat. Acad. Sci.). Geophysics at the Brussels Meetings, July 18–28, 1919, L. A. Bauer, Science, Oct. 31, 1919. The New International Union of Pure and Applied Chemistry, Edward W. Washburn, Science, Oct. 3, 1919.

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The most important international event of the year, from the scientific point of view, was the definitive organization of the International Research Council and its affiliated unions at Brussels, July 18–28, 1919. The United States was represented at these meetings by 21 delegates, under the chairmanship of Dr. W. W. Campbell, director of the Lick Observatory, who served during the meetings as a member of the executive committee of the International Research Council. The interesting and important details of the proceedings, which can not be given here because of limitations of space, should be sought in the printed reports.

The International Research Council brings into effect the plan proposed by the Council of the National Academy of Sciences at the interallied conference held in London in October, 1918, under the auspices of the Royal Society, and indorsed by the National Academy at its autumn meeting of the same year. The purpose in view was to establish a federation of research agencies in each of the participating countries, and to form the International Research Council of representatives of these federations. In harmony with this plan, the Council of the National Academy, at a meeting held December 19, 1919, authorized the National Research Council, acting through its division of foreign relations, to represent the United States in the International Research Council. By action of the Academy council and the executive board of the National Research Council, the foreign secretary of the National Academy is ex officio chairman of the division of foreign relations.

III. Division of States Relations.

JOHN C. MERRIAM, *Chairman.*

Upon the reorganization of the National Research Council in the spring of 1919, the relations of the council with State research committees, which had formerly been in charge of the section on relations with educational institutions and States committees, were given to the division of States relations. The organization of this division was completed on December 22, 1919, and the personnel is to be found in Appendix A. The objects of this division are the promotion of scientific activity within the States as units, with special reference to educational, commercial, industrial, governmental agencies; the application of scientific knowledge to public welfare; the coordination of effort among all the scientific agencies of the State; and a study of the problem of the relations between the scientific agencies of the State and those of the Federal Government. The first business of the division will accordingly be thorough study of the various situations presented by several typical States and their relations to the Federal Government to determine how these purposes may best

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be realized. There are already in view a number of State situations in which the need for effective and concerted action in the development and application of scientific knowledge is fully realized, and it is believed that the example of certain of the more progressive States in which successful State organizations have been effected will lead during the coming year to the improvement of conditions in other States.

It is planned to make use as widely as possible of the State research committees which were organized during the period of the war under the auspices of the State councils of defense. So far as feasible, it is intended to utilize these committees through a regional grouping represented in some manner later to be determined in the States relations division. These regional divisions will also be employed for general administrative purposes. They are as follows:

1. Pacific coast region: Washington, Oregon, California, Idaho, Nevada, Utah, Arizona.

2. West central region: North Dakota, South Dakota, Nebraska, Kansas, Montana, Colorado, Wyoming.

3. East central region: Minnesota, Iowa, Wisconsin, Michigan, Illinois, Ohio, Indiana, Kentucky.

4. South central region: New Mexico, Texas, Oklahoma, Missouri, Arkansas, Louisiana.

5. South Atlantic region: Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Tennessee, Mississippi.

6. North Atlantic region: Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, New Jersey, Maryland, Delaware, District of Columbia.

IV. Division of Educational Relations.

VERNON KELLOGG, *Chairman.*

With the reorganization of the National Research Council on a peace basis in the spring of 1919 the work of the former section on relations with educational institutions and State committees was divided, and the relations of the council with educational institutions were delegated to the newly-formed division of educational relations. The membership of this division, authorized by action of the interim committee at its meeting April 8, 1919, has now been completed with the exception of the appointment of six regional representatives. See Appendix A.

This division regards its function as the stimulation of research and the training for research in educational institutions, especially colleges and universities. Before entering upon any extensive program for active effort in this direction, however, it seems necessary to attempt a thorough study of the conditions in American institutions of higher learning that at present directly relate to the progress

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of research. This study has been made possible by a grant of $10,000 from the General Education Board.

The preliminary portion of this study consists of a survey by the questionnaire method, which is now practically completed. Answers have been received from over 300 colleges and universities. The purpose of this questionnaire survey was to secure certain general information upon facilities for research and also a representative expression of opinion upon these conditions in our present system of higher education, which should be given particular consideration in this connection.

This preliminary study is now being followed up by personal visits to the colleges and universities by men who are familiar with the purposes of the council. These visitors introduce the council to the administrators and scientific men of the institutions visited, explain the desire of the council for cordial cooperation in the study of the problems of the promotion of research, and make a personal report to the council upon the general situation of research of various sections of the country, as found in these institutions. Three representatives of the council have already made trips in the interests of this survey: Prof. C. E. McClung, chairman of the division of biology and agriculture, visited the major institutions of Kansas and Missouri during October; Prof. W. F. Durand, of Stanford University, the major institutions of Oregon, Washington, Idaho, Utah, and Nevada during November; and Prof. F. B. Dains, University of Kansas, institutions in Wyoming, Montana, and North and South Dakota at about the same time. It is expected that the field work for this general survey by personal visitation will be completed during the spring of 1920, and that a general report embodying the information gained will be compiled during the coming summer under the direction of the chairman of the division.

In addition to the general survey of research conditions previously outlined, a series of special surveys is proposed covering exhaustively the conditions affecting research in the several fields of science.

The organization meeting of the division was held in Washington on June 25, 1919. The second meeting of the division was held in Washington on November 5, at which the results of a preliminary inspection of the research questionnaires returned to that time were presented and discussed and at which the chairman was authorized to proceed with the research survey as it had been planned. A third meeting of the division was held in New York City on December 23, at which the full report upon the questionnaire and the development of plans for continuing the survey during the early part of 1920 were considered.

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V. Division of Research Extension.

JOHN JOHNSTON, *Chairman.*

The division was organized June 12, 1919, under the title "division of industrial relations." The grounds leading to the change of name have been discussed at an earlier point in this report by the chairman of the council. In the report of the committee appointed to recommend the details of the organization of the division (presented to the interim committee April 8, 1919) it is stated that the work of the division "should be largely so directed as to stimulate industrial administrators to broaden their research activities and to persuade the smaller industries to combine for the creation and maintenance of efficient research laboratories for the common good." The personnel of the division as finally organized will be found in Appendix A.

The division has been chiefly occupied with a survey of the possibilities for cooperative research in several of the industries and with preliminary work in the fields of alloys and cotton, looking toward the establishment of research associations.

While it is not the intention of the division to emphasize the association plan as its sole method for the stimulation of research in the industries, it has seemed that the two instances mentioned offered unusual opportunities for cooperative work, as is also the case with the baking industry, where an institute has been established through cooperative effort in which we have joined.

Alloys.—Owing to the number of interests represented in alloys and the work already under way in Government bureaus, under certain committees of the council, and in industrial laboratories, it has been necessary to proceed cautiously and slowly. The division seems to have been successful in obtaining cooperation in most quarters and has formulated a tentative plan which is now in the hands of a number of individuals for criticism. The project of an alloys research association was presented in addresses before the National Exposition of Chemical Industries, the American Institute of Mechanical Engineers, the American Chemical Society, the American Foundrymen's Association, and the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers. This last-named meeting was particularly important from the standpoint of the council, as the reception which the project received and the indorsement given the general plan was most encouraging.

In order to have the guidance of men long associated with alloys, an advisory committee on alloys research has been formed, subject to the approval of the interim committee, and these gentlemen have already given much consideration and advice.

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While the industries have not been formally invited to become members of the association, those that have been approached in an informal way have expressed interest and willingness to support the work. An energetic campaign for members will be launched following a meeting of the division with the advisory committee in February, when a final outline will be formulated.

Baking.—In September the vice chairman of the division, Mr. Harrison E. Howe, was invited to cooperate with the American Association of the Baking Industry, and in Chicago had an opportunity to assist the officers of that association in organizing the American Institute of Baking. The idea for this institute came from Dr. Win Campbell as a result of his activity in war work, but it has been necessary to bring research before the bakers in a forceful way, and it is very gratifying that their support has been secured for fundamental research in their industry. We believe it will be one of the best examples of what cooperation can accomplish, for obviously few of the 28,000 bakers in the country could really afford to support research for their exclusive benefit, but they can engage cooperatively upon an ambitious program without the element of competition being interjected. The institute plans to conduct a research laboratory, a service laboratory, and to assist in the education of those engaged in or about to engage in the baking industry. The National Research Council has appointed an advisory committee for the institute, and this committee will work in cooperation with the director of the institute, Dr. H. E. Barnard.

Cotton.—Last year the chairman and other members of the council appeared before the annual meeting of the National Association of Cotton Manufacturers and addressed them relative to industrial research. The association has had a committee considering what could be done in the industry, and as a result of the stimulation derived from the addresses given, research was given a place in the World Cotton Conference held in New Orleans in October last. The vice-chairman of this division was made secretary of the committee on research, reports and statistics, and by reason of that office had opportunity to come into close contact with a considerable number of both foreign and national representatives of various branches of the cotton trade. A number of meetings were held in New York, Washington, and New Orleans, at which many topics were discussed, and those having widely differing opinions brought together. As a result of this effort, the committee has now been formed, and is about to take up its work.

Few realize the importance of cotton and the somewhat disturbing situation which now exists especially with reference to supplying the world's need of long fiber. By comparison with other industries in

166503°—20—S. Doc. 238, 66-2——6

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which organized research has been employed, the textile industry appears in an unfavorable light, and it is believed that a wonderful opportunity presents itself to assist the public at large through the application of research. This will also result in great benefit to those employed, since in general those industries where science is consistently applied, attract a higher class of employees, and arouse a greater interest among employers in the conduct of their business.

Tanning.—The Tanners' Council of the United States formed a laboratory a few years ago to work upon certain problems relative to the manufacture of leather. Visits were made to the laboratory, where the work in progress was discussed with its director, with the purpose of learning to what extent real research is being carried on and whether there seems to be an opportunity for the National Research Council to aid this large industry through the already established laboratory. The possibilities are now under the consideration of the division, upon which a specialist in leather is serving, and it is planned to present to the Tanners' Council a program for research to be conducted in its own laboratory, or elsewhere, as may seem best. The Tanners' Council has also announced its intention of establishing a leather school, and the division has offered its assistance in studying the problems involved.

Glass.—Great Britain has formed a research association in the glass industry and in cooperation with the committee on ceramics of the division of chemistry and chemical technology the division has arranged to discuss the possibilities here before the glass division of the American Ceramic Society when it meets in February. Preliminary work is now under way with reference to that meeting, and it is believed that an opportunity will be found to interest the industry at large in undertaking some of the researches.

Cooperation with the division of biology and agriculture.—The division of research extension has been interested in two special committees of the division of biology and agriculture, namely, food and nutrition, and forestry. We have been able to bring the plans of these committees to the attention of several industries, and are now in active cooperation with the division with respect to assisting in the organization and financial work which must precede the carrying out of the program which has been outlined.

Miscellaneous.—Initial steps have been taken to learn the possibilities for fundamental research in the production of enameled metal ware, new uses for glass containers, cooperative research among the ice-cream manufacturers, and manufacturers of refractories. Contact has been established with the Asphalt Association.

Wireless telephone exhibit.—Dr. Hale conceived the excellent plan of having on exhibition the latest achievements of industrial research which could not have been accomplished without the pure

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or scientific research generally undertaken without reference to immediate commercial application. The first exhibit chosen was that of the wireless telephone, and arrangements were made with the Western Electric Co. to install a popular exhibit in the display room of the council. Final arrangements were made in July, and since that time the engineers of the Western Electric Co. have been working out automatic devices which would illustrate the principal academic experiments involved in the present wireless telephone. Motion pictures, including moving-line drawings, are in preparation, a considerable number of portraits of original investigators, and a series of diagrams have been prepared. Col. Carty has consented to deliver an opening lecture on the wireless telephone. The Signal Corps and the Air Service have cooperated in working out the plans for the exhibit, and will loan certain materials for our use. It is now expected that this exhibit will be ready for the public early in January. It is hoped that this and similar subsequent exhibits of achievement in pure and applied science may be shown in other cities throughout the country.

VI. Research Information Service.

Robert M. Yerkes, *Chairman.*

The division was organized May 29, 1919, in accordance with a plan adopted by the interim committee April 8, 1919, which determined that the membership of the division should consist of:

(1) The chairman of each division of the National Research Council.

(2) A representative of each of the 10 departments of the United States Government.

(3) Members at large, not to exceed 10, representing institutions or other organizations of special importance for the service.

For detail of personnel, see Appendix A.

The division is designed to continue and develop the useful service which it rendered during the war. When its facilities are completely developed, it should constitute an effective national center of information concerning American research work and research workers, with all of its information promptly available to institutions or individuals interested in knowing what problems are under investigation, their status, and any other significant matters relating to the progress of research.

The mechanisms of personnel for the division thus far authorized are: (1) A divisional committee of 34 members, (2) an executive committee of 5 members, (3) a resident staff of 6 members, (4) a staff of correspondents representing various important sources of

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research information in various sections of the country. This staff has not yet been organized.

The division has recommended the development of the following mechanisms of information, certain of which have already been launched and the status of which is briefly indicated in the following paragraphs:

(*a*) A catalogue of research laboratories. (It will be understood throughout this report that research includes both scientific and industrial investigative activities.) This catalogue, which is nearing completion, already includes approximately 5,000 cards. It renders available, in addition to the name and address of the organization, its director, personnel, chief lines of research, laboratory space, annual expenditure, etc.

(*b*) Catalogue of current investigations. A card has been prepared for the tabulating of what promises to be important information concerning research in progress. An initial edition of the card has been printed and awaits distribution. The current investigation project has been carefully considered by several divisions of the council in addition to the research information service and it is deemed desirable to make an experimental test of the possibility of assembling information concerning the current work, as well as of the practical usefulness of such information. With the current investigation card it is planned to send each laboratory or investigator, either separately or printed on back of card, the general information concerning the current investigation file.

(*c*) A catalogue of research personnel. For the purpose of securing and filing the desired information concerning investigators a card has been prepared by the research information service with the constructive criticism of numerous individuals and divisions of the council. An initial edition of this card has been printed and is ready for distribution. Important demands for information concerning research personnel have already been made by outside agencies.

(*d*) The development of a library of sources of research information has been approved by the division, but on account of limited funds nothing has yet been done toward creating such a library. It is planned to include in this collection bibliographies, systematic abstracts, digests, handbooks, and other convenient periodical or special sources of information concerning research. As a preparatory step toward the establishment of a library a catalogue of bibliographic and abstract periodicals of the world has been prepared. It will later be issued as a bulletin of the council.

(*e*) For the use of the several divisions a catalogue of scientific and technical societies, with information concerning time and place of meeting, has been prepared and is maintained by the service.

(*f*) All foreign reports received by the research information service have been indexed for convenience of reference. This index now includes approximately 12,000 cards.

(*g*) The minutes of the National Research Council have also been indexed for the convenience of the office of the secretary and the several divisions.

(*h*) A plan for improving the status of scientific publications, and especially for rendering abstracting and the construction of books more satisfactory, has been formulated by the service. This plan involves cooperation with the several divisions of the council in the conduct of systematic inquiry concerning the status of publication in special fields and possible ways of improving conditions. With respect to bibliographic listing and abstracting, the

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following are the outstanding features of the general plan which has been formulated by Dr. G. S. Fulcher:

(1) The formulation of carefully considered and thoroughly tested rules for the preparation of abstracts in any given field of science.

(2) The editorial requirement that a suitable abstract prepared in accordance with these rules be submitted with a manuscript when offered for publication.

(3) That said author's abstract, after proper editing, be published in a periodical (usually monthly) abstract journal for the appropriate science.

(4) That all abstracts be held in type for at least one year in order that the materials may be reclassified according to subject and reprinted as an annual topical review.

(5) That as essential parts of the annual topical review for any given field of science there be published also complete author and subject lists.

(6) That such author and subject lists be accumulated and published in separate volumes at intervals of 5 or 10 years.

Already encouraging progress has been made in the development of this general plan. Several journals have already agreed to give one or more features of this program a trial. Its ideal execution will demand international cooperation, but it is possible for the Research Council to prepare the way effectively for such cooperation by developing methods and, through cooperation with special scientific groups, establishing suitable abstract or other periodicals.

(*i*) The research information service (subsequently the committee on publication, on which the chairman of the service serves as chairman) has furthered the development of plans for National Research Council publications, the present status of which has been indicated by the chairman of the council at an earlier point in this report.

The research information service has in addition to the above activities developed several minor catalogues and assembled varied sorts of information for special purposes. A collection of catalogues of educational institutions made during the last six months has proved extremely useful to the divisions of educational relations, States relations, and geology and geography, as well as to the research information service.

B. DIVISIONS OF SCIENCE AND TECHNOLOGY.

VII. Division of Physical Sciences.

C. E. Mendenhall, *Chairman.*

The division of physical sciences was organized May 1, 1919. For a statement of the personnel, see Appendix A. The appropriate sections of the division have given extended attention to the reports of the delegates at the Brussels meetings of the International Astronomical Union and the International Union of Geodesy and Geophysics. It is expected to present shortly to the executive board recommendations regarding the American sections of these international unions. Consideration has also been given to the organization of the future international union of mathematics.

In accordance with the general scheme adopted by the division, research committees are now either organized or in process of organization to deal with the following topics: Atomic structure;

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celestial mechanics; X-ray spectra; foundations of electrodynamic theory; electrodynamics of moving media; photo-electric effects; specific heats; thermo and magneto electric effects; dispersion, absorption, and scattering of light; luminescence. Further committees are also under consideration to deal with special topics in spectroscopy, experimental investigation in magnetism, the fundamental theory of magnetism, crystal structure.

A liaison research committee, including mathematicians and physicists, is under discussion, and the organization of similar committees to include physicists and representatives of the medical sciences is being considered by the two divisions.

After discussion with the president of the American Astronomical Society, it was decided that the division should support two of the committees of that society, i. e., the one on meteors and the one on parallaxes, but it is not deemed wise to form additional committees in the field of astronomy.

All of the above committee work is supported by a special grant from the Rockefeller Foundation.

The chairman has continued to act in the liaison capacity between certain American governmental groups and the corresponding groups in England. He has also represented the division on the Rockefeller fellowship board, and carried on correspondence connected with the National Research Council fellowships in physics.

In cooperation with the chairman of the division of chemistry and chemical technology, the chairman has conducted a considerable amount of correspondence with reference to the Critical Tables of Physical and Chemical Constants, whose publication is a joint project of the two divisions.

The committee on abstracts, bibliographies, and monographs has been in continued negotiation with the Physical Review and the Astrophysical Journal, and these two publications have adopted its recommendation to publish abstracts with all articles.

VIII. Division of Engineering.

Comfort A. Adams, *Chairman.*

The division was organized on March 26, 1919, with Dr. Henry M. Howe as chairman and Mr. G. H. Clevenger as vice chairman. For the present personnel see Appendix A.

On September 9, 1919, following the resignation of Dr. Howe as chairman, Dr. Comfort A. Adams was nominated as chairman of the division and, upon later approval by the executive board, entered upon his office October 6, 1919. Dr. Howe was, upon recommendation of the division, appointed to the special office of honorary chairman.

During the past six months the division of engineering has been largely occupied with the adjustment to peace-time conditions, includ-

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ing (1) the completion or discontinuance of the work of strictly war committees; (2) the reorganization of the work of committees to be continued; (3) the organization of new committees; (4) consideration of methods of financing committee work; (5) discussion of the proper field of activity of the division of engineering, particularly (*a*) as related to the field of activity of the division of research extension, and also (*b*) with reference to the type of engineering research which can be safely conducted on the cooperative plan without danger of conflict with commercial interests; and (6) the establishment of cooperative relations with societies and Government bureaus engaged in research work in the engineering field.

The following brief accounts of committee work may suffice to give an impression of the current situation. Mention will be made first of the work of committees holding over from the war-time organization.

Committee on fatigue phenomena of metals.—Prof. H. F. Moore, the chairman of the committee, carried out during the war an important series of tests which tended to show that the elevation of the elastic limit caused by plastic deformation was ineffective as regards endurance. Because of the change to peace conditions, a wholly new, broad, and comprehensive program has been adopted which should yield results of the first importance.

A contract has been entered into as between the University of Illinois on the one hand, and Engineering Foundation and the Natioal Research Council on the other, whereby Engineering Foundation is to grant a subvention of $15,000 a year for two years, the research work to be carried on in the laboratories of the university under Prof. Moore's direction. A staff of four or five research assistants is being organized, and the university is fitting up a special laboratory, with some 2,500 square feet of floor space, for this work.

Committee on the heat treatment of carbon steel (Dr. Henry M. Howe, chairman).—The great bulk of the steel for engineering and other industrial purposes will presumably continue for many decades to be carbon steel. It is known that the physical properties of this steel can be very greatly improved by suitable thermal treatment, which in many cases need not be costly.

The general plan is to experiment on special lots of steel supplied to the division by the courtesy of several steel companies. Most of the experimentation will be carried on in the Bedford Hills laboratory of Dr. Howe. The various physical tests will be made elsewhere, for example, at the Bureau of Standards, at the Bureau of Mines, at certain university and industrial laboratories, and at the Watertown Arsenal. The attempt will be made to correlate heat treatment, microstructure, and physical properties.

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The Bureau of Standards and the Bureau of Mines have combined to make a subvention of $9,600, including in this sum salary for the services of Mr. F. B. Foley, of the Bureau of Mines. Special apparatus has already been designed and built, and satisfactory progress is being made.

Interpretation of the results will undoubtedly be difficult but extremely important. Cooperation in this matter has been promised by the following: Prof. Albert Sauveur, Harvard University; W. E. Ruder, General Electric Co.; William Campbell, Columbia University; M. Portevin, Conservatoire des Arts et Metiers, Paris; Dr. Walter Rosenhain, National Physical Laboratory, England; Dr. John E. Stead, England.

Committee on physical changes in iron and steel below the thermal critical range (Prof. Zay Jeffries, chairman).—It has long been known that working steel at a blue heat, and even simple exposure to blue heat under certain conditions, may injure it seriously. Three important reports on work accomplished by the committee have already been submitted under dates of November 20, 1918, February 4, 1919, and April 4, 1919. Further work has been assigned to a group of experts who will carry forward the investigations on different aspects of the problem.

Pyrometer committee (Dr. G. K. Burgess, chairman).—The purpose of this committee has been to discover improvements in pyrometry, including the measurement of the temperature of the bath of steel in the open hearth and electric steel-making processes. Direct experiments have been made at the Midvale Steel Works with an optical pyrometer sighted on the bottom of a closed tube of refractory material immersed in the bath. The committee finds that by the Burgess method it is practicable to measure the temperature of metal under the conditions named to between 10° and 20° C. The cost of the experiments has been borne by the industries concerned. The committee contributed to the Transactions of the American Institute of Mining and Metallurgical Engineers a symposium of 57 papers, which are to be issued as a separate volume. This is the most important event in pyrometery since the invention of the Le Chatelier pyrometer. The chairman is preparing an abstract of the report of his committee, to be printed and distributed to steel manufacturers and the technical press.

Committee on substitute deoxidizers (Dr. J. R. Cain, chairman).—The purpose of this committee was to find ways of saving manganese as a war measure, by replacing the iron manganese alloys now used for deoxidizing steel made by the Bessemer, open hearth, and electric processes. The work has been carried on in numerous laboratories throughout the country, and about one-third of the original

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program has been completed. Lack of funds has seriously interfered with the progress of the research.

Committee on alloy steels (Dr. J. A. Mathews, chairman).—In this subject an enormous amount of information exists wholly unclassified. The chairman has therefore proposed the preparation of a series of monographs to be written on the more important alloy steels as preliminary to attempting further investigation. At the moment, but one branch of the experimental work is in actual progress, to wit, that on chromium steel alloys, which is being conducted under Prof. E. D. Campbell by Mr. Zimmerli, an instructor at the University of Michigan.

Committee on helmets and body armor (Maj. Bashford Dean, chairman).—The work of this committee was carried on in close cooperation with that of the engineering division of the Ordnance Department, the chairman later becoming the chief of the armor unit of the Ordnance Department. The purpose of the committee was to improve the design of helmets and body armor, and to find steel of great ballistic resistance when in thin sheets. The metallurgical work was done largely by the committee, with the aid of appropriations from the Ordnance Department. In addition to 15 valuable special reports, a final general report has been submitted by the chairman, and the committee has been discharged.

Committee on Neumann bands (Prof. C. E. Munroe, chairman).—The chairman has presented results of experiments indicating that there is some relation between the number of Neumann bands in broken fragments of steel and the velocity of rupture. This is most valuable information, and contrary to the previous opinions of experts. It is hoped by the continuation of this work to establish some definitely quantitative relations. (Compare the report of the division of chemistry and chemical technology below.)

Committee on manganese saving (Dr. J. E. Johnson, jr., chairman).—The important results in the work of this committee in the conserving of manganese, both in smelting and in its use as a recarburizer, was exhibited in two papers presented to the February meeting, 1919, of the American Institute of Mining and Metallurgical Engineers. A full report of the work of the committee has been presented by Mr. S. L. Hoyt, and the committee has been discharged.

Committee on steel ingots (Col. W. P. Barba, chairman).—This committee was formed during the war to take advantage of the then patriotic frame of mind of steel manufacturers to draw up forms and specifications for the recommended practice. At a recent meeting of the committee the paper prepared by Col. Barba and Dr. Howe, which summarizes the best practice in the manufacture of ingots for guns, was considered. It was voted that whereas the information

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contributed was primarily for the benefit of the Government during the war, and whereas its publication would constitute an aid to the manufacturers of other nations, the paper should be placed on file in the archives of the National Research Council, labeled confidential, and at the disposal of the War and Navy Departments. It was also voted that the paper should be submitted to the members of the committee for recommendations as to reservations, and that the non-reserved portions be published. This paper is now being revised for publication. The change thus brought about consists chiefly in the substitution of general recommendations for quantitative specifications. The question as to the continuance of the work of the committee is under consideration.

Committee on new hardness testing machine (Prof. H. F. Whittemore, chairman).—A comprehensive bibliography has been prepared, and the committee has planned the preparation of a report on the present status of the hardness testing of metals. Practical work is held in abeyance for lack of funds.

Committee on elimination of sonims of steel (Dr. Henry D. Hibbard, chairman).—It is proposed to study the sources, methods of occurrence, and effects of sonims, as well as means of eliminating them from steel. A dozen of the steel companies have been enlisted to some extent in the work, and there has been already published an important paper by the chairman, which was presented to the American Iron and Steel Institute.

It is proposed to try to form a syndicate of the beneficiaries of the investigations in this line to carry the work forward toward completion.

New committees have been appointed as follows:

Committee on study of high speed tool steels (Mr. J. V. Emmons, of Cleveland, chairman).—The problem confronting this committee is to secure steel, together with a heat treatment for the same, which will combine the greatest possible cutting efficiency with the least possible cost.

Committee on core losses (Dr. A. E. Kennelly, Harvard University, chairman).—The purpose of this research is to reduce the calculation of the core losses in electrical machinery to a reasonably scientific basis. At the present time only about one-third of these losses are computed, and the remainder is covered by a factor of ignorance, which varies with the type of machine.

Highway research committee (Dean Anson Marston, chairman, with Prof. A. N. Talbot and Messrs. H. H. Porter and G. S. Webster as colleagues).—The purpose of this committee is to coordinate and assist the work now being conducted by the United States Bureau of Public Roads, by State highway departments, by manufacturers, research departments, and commercial laboratories. The United

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States Chief of Public Roads has been made a member of the division of engineering, and is in active contact with the work of the committee, which has already submitted a comprehensive report and program. The work of the highway research committee will involve no special expenditure on the part of the Research Council, as the funds will be supplied by the cooperating Federal, State, and municipal departments. However, the task of coordination and of developing the cooperative spirit is no small one. The national importance of the work can hardly be overestimated.

COOPERATION WITH OTHER ORGANIZATIONS.

American Bureau of Welding.—This bureau is organized substantially as outlined below in connection with a discussion of finance and organization and includes representatives of all the large interests in the welding field—industrial, governmental, and scientific.

The research committees of this bureau are also committees of the division of engineering.

American Society of Mechanical Engineers.—This society has five active research committees under the general chairmanship of Prof. A. M. Greene, who is a member of the division of engineering.

Plans are now under way for the official connection of these committees to this division.

American Society of Heating and Ventilating Engineers.—This society is carrying on a large amount of research work in its field and has a research laboratory in Pittsburgh. It has cordially welcomed cooperation with the division of engineering and is being invited to appoint a representative to the division in order to secure cooperation.

It is thus quite probable that the research work of this society will shortly be attached to the division of engineering.

American Society for Testing Materials.—The work of this society is closely allied to that of the division of engineering, on which it is represented. Research work is frequently required as a specific basis for its specifications. The division of engineering is officially represented on some of these committees, and close cooperation exists in all cases.

Bureau of Public Roads, Department of Agriculture.—As mentioned under "Highway research program," Mr. T. H. McDonald, chief of this bureau, has been made a member of this division.

ORGANIZATION AND FINANCE.

The active committees of the division are chiefly financed by Engineering Foundation and by Government bureaus, the funds supplied by the National Research Council being only sufficient for the over-

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head administrative expenses, including a modest allowance for travel. In certain instances, manufacturing companies supply materials of considerable value without charge. In the case of certain of the committees, their work is being carried on (*a*) in university laboratories by volunteer or student assistants; (*b*) in Government bureau laboratories; or (*c*) in certain instances in industrial laboratories.

The amount of work which can be done through any of these agencies without cost is comparatively limited, and it is becoming more and more obvious that if the division is to perform its proper functions in the field of industrial research funds must be available for the employment of competent men not only as research assistants but also to direct the work. Volunteer service is in most cases highly unsatisfactory. Certainly the direction of important researches should be in the hands of high-grade men paid enough to warrant their giving a material part of their time to the work.

Efforts have been made to finance individual researches by approach to the interested industries, but with moderate success only. Moreover, where many researches in the same or other fields are involved, this is an exceedingly laborious and inefficient method, involving many appeals to the same industry. The Engineering Foundation board is planning a large increase in its endowment, and as a considerable part of the income of this endowment is used for the research work of this division, there are good prospects of a substantial increase from this quarter. However, this can never fully meet the needs of engineering research as a whole, and as a matter of fairness should not, as the benefited industries ought to bear the major part of the burden.

As a result of these considerations, the division of engineering is now developing a plan of organization and finance, herewith briefly outlined:

A general committee, board, or bureau of an industry is organized, consisting of representatives from the several corporations willing to cooperate, of representatives of interested societies and Government bureaus, and of other experts and scientists in the particular field.

This general committee will select the problems in most need of solution, will organize subcommittees for the handling of these problems, will secure from the corporations involved general contributions for its whole group of researches, will act as the coordinating link between the several subcommittees, and serve in a general advisory capacity. The chairmen of the subcommittees will in general be members of the general committee.

Two industries now being organized in this way are the steel industry and the electrical industry.

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The chairman of this division has already applied this method successfully to the organization of the welding industry in the American Bureau of Welding, the research committees of which are officially attached to the division of engineering.

It should be noted that this is substantially the plan proposed by the division of research extension for the organization of the Alloys Research Association.

There has been much discussion within the division and with high officials of large industries as to the danger of commercial complications likely to arise in connection with the cooperative conduct of industrial research, and the cordial support of some of the larger corporations is at present contingent on the confinement of the cooperative research to such fundamental problems as are not likely to involve questions of patents or secret processes. There is, however, a large field of such fundamental problems. Moreover, there are many smaller corporations willing to cooperate even in the debatable field. It is becoming more and more obvious that the type of research, as well as the form of organization, must be adapted to the particular industry and the grouping of the corporations in that industry.

In conclusion, it is clear that while the appreciation of the need for industrial research is spreading rapidly, much remains to be done in the way of a campaign of education.

IX. Division of Chemistry and Chemical Technology.

Wilder D. Bancroft, *Chairman.*

The division was organized March 21, 1919. For personnel, see Appendix A.

With two exceptions, practically all the war-time researches carried on by the members of the chemical committees of the council had been completed prior to the new organization, have been turned over to other agencies, or have been discontinued. The committee on synthetic drugs has not yet made a final report. This work is referred to below. The committee on research in explosives has been carried forward, as will also be indicated later in the report.

By action of the International Union of Pure and Applied Chemistry and by action of the International Research Council, the division of chemistry and chemical technology becomes the American representative of these two bodies, and is charged, jointly with the division of physics, with the duty of publishing critical volumes of physical and chemical data. A board of three trustees to handle the business details has been appointed, and consists of the chairman, H. K. Moore, appointed by the chairman of the National Research Council; Julius Stieglitz, appointed by the president of the American

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Chemical Society; and E. P. Hyde, appointed by the president of the American Physical Society. These trustees are now trying to raise a fund of $100,000 to meet the estimated expenses of the project. This money will be deposited with the treasurer of the National Research Council and will be disbursed by him. The scientific part of the work will be under the direction of a chairman appointed by the chairman of the National Research Council, the president of the American Chemical Society, and the president of the American Physical Society, and an advisory board of six, three of them appointed by the division of chemistry and chemical technology and three by the division of physics.

The committee on chemical journals, Mr. A. B. Lamb, chairman, was formed to consider the question from a scientific viewpoint as to what special chemical journals and what international chemical journals were desirable. While this problem has come up before the American Chemical Society, it has always been discussed on a pragmatic basis of what might be feasible at the moment. It is quite conceivable that the ideal plan might be very different from any which could be handled at once.

The committee on explosives investigations has as chairman Mr. Charles E. Munroe, who has been conjointly assigned to this work by the Bureau of Mines, the Ordnance Department of the Navy, and the Ordnance Department of the Army. He has been engaged in arranging for and supervising investigations on the corrosion of rifle barrels; the study of Neumann bands as a means of determining whether a fracture in metal is due to mechanical stress or strain, or to the effects of an explosion; the products of combustion and detonation of T. N. T.; the heats of combustion and detonation of T. N. T. isomers; the fudging of ammonium nitrate and the effect of this material on the rate of detonation of gelatine dynamite; desensitization of explosives for storage; the determination of nitrosucrose in the presence of nitroglycerine; the production of flashless powder; the development of an ultrasensitive detonator for mines. The committee is bringing the Index to the Literature of Explosives up to the beginning of "Chemical Abstracts." It has arranged for cooperative work between the Bureau of Mines and the University of Wisconsin; between the Bureau of Mines and the E. I. du Pont de Nemours Co.; and between the War Department and various universities. The committee has also acted as a general bureau of information, and has been called upon for service by a large number of the divisions of the Departments of State, War, Navy, Agriculture, and the Interior.

The committee on synthetic drugs, Mr. Julius Stieglitz, chairman, was active during the war, and has continued its good work. In addition to helping develop methods for making needed drugs, the

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committee has cooperated closely with the Federal Trade Commission, with the Alien Property Custodian, and with the Chemical Foundation to secure the importation of such drugs as could not be made here, and to utilize the patents taken over from enemy alien owners.

The committee on the chemistry of colloids, Mr. H. N. Holmes, chairman, has arranged for the preparation of a monograph on colloid chemistry and of laboratory manuals on colloid chemistry and on the use of the ultramicroscope. The monograph is practically done, and will be sent to the publisher as soon as the American Chemical Society decides what action it wishes to take in cooperation. A number of single lectures have been given by different members of the committee before sections of the American Chemical Society. The chairman of the division is giving a course of 20 lectures on colloid chemistry before the research staff of the Goodrich Rubber Co. and a course of 30 lectures on the same subject at the Bureau of Standards. He is also to give a course of three lectures on contact catalysis before the chemists of the Du Pont Co. at Wilmington. The State College of Washington and the Universities of Washington, Oregon, Montana, and Idaho have asked that somebody be sent on a trip through this region to give some lectures on colloid chemistry, and it is probable that Mr. Holmes will do this, stopping also at Chicago, Milwaukee, Madison, and Minneapolis. The committee is making arrangements with the instrument companies to furnish better types of apparatus for the use of colloid chemists.

The committee on ceramic research, Mr. A. V. Bleininger, chairman, is a joint committee with the American Ceramic Society. It has formulated a plan for research fellowships in ceramic research to be supported by the industry, and is now trying to raise funds for this purpose. It is also planning to keep track of all research work that may be of direct or indirect interest to the ceramic industries.

The committee on sewage disposal was organized with Mr. G. C. Whipple as chairman, but he is going to Europe, so the chairmanship has been taken by Mr. Edward Bartow. No active work has been done by this committee as yet; but it is believed that there is an important field in which it will prove useful.

The division of chemistry and chemical technology is trying to do three things: (1) To formulate special research problems for individuals; (2) to formulate general problems of fundamental importance involving cooperative work; (3) to bring together men in different branches of chemistry or men in different branches of science, each of whom is familiar with a given subject from a point of view not held by the others.

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(1) A number of research problems have been formulated in colloid chemistry, electrochemistry, and analytical chemistry, and are available. A few of these problems are being studied at different places. The amount of this work will increase as time goes on, but it does not seem probable that it will ever be a very important feature of the division's work.

(2) The three committees now most active along the line of formulating general problems of importance are those on synthetic drugs, colloid chemistry, and ceramics. A committee is being organized to secure cooperative and systematic work on the determination of the free energy of chemical compounds. An informal committee has been arranged which is to get the subject of contact catalysis into such shape, if possible, that this can be made a test case. As there are at least five laboratories very much interested in the subject, it seems quite possible that something well worth while can be done. In the course of time it is hoped that something similar can be done in the other fields of chemistry. A committee is being organized to see whether certain changes in the teaching of organic chemistry may not be both desirable and practicable.

(3) The committee on sewage disposal brings together the sanitary chemists, the physical chemists, and the colloid chemists and is the one case of this sort which we have at present. The contact among the divisions is probably one of the most important features of the work of the National Research Council. So far as the chemists are concerned, the prospects are very good, but there are no actual results as yet. We are getting into touch with the physicists in regard to instruments and methods to be used by the chemists. Some research work is under way with regard to some points in the theory of viscosity of colloidal solutions, and work is being done at Kodak Park which may enable us to present such facts in regard to the color of colloidal metals as will make necessary a revision of the optical theories in regard to the matter. The research work now being done at Golden, Colo., in cooperation with the Bureau of Mines, on the colors of gems, may tie in with work by the physicists on X-ray spectra of gems and of metallic oxide jellies.

The division hopes to cooperate closely with the geologists in regard to the theory of sedimentary rocks, because the actual process of sedimentation is essentially a problem for the physical chemist and the colloid chemist, who, however, do not know enough of the geological side to be able to apply the results of the laboratory work in any satisfactory way. The problem of the future supply of radium for medical purposes is one which the division of chemistry is calling to the attention of the division of medicine. The preparation of the rarer sugars in pure form for use in the study of enzymes is one thing

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in which the chemists can help. The whole field of chemotherapy is an important one which will have to be developed jointly.

The chemists and the biologists will cooperate in the work of the Institute of Baking. The question of structural colors in nature is one for the biologist, the physicist, and the chemist. There are great possibilities for cooperation between the chemist and the biologist in the increase of food values and in the development of new varieties of food. The theory of the action of the blister and tear gases used in the late war is a problem for the chemist, biologist, and medical man.

X. Division of Geology and Geography.

E. B. Mathews, *Chairman.*

The division was organized May 1, 1919, but the final arrangement of officers for the current year was not completed until later, the affairs of the division in the meantime having been conducted partly by temporary officers and committees, but in the main under the direction of the vice chairman, Edward B. Mathews, who was appointed to the chairmanship on October 24, 1919. For personnel see Appendix A.

Practically all of the war-time activities of the committees on geology and geography had come to a close prior to the organization of the division in its new form. The work of the division has been largely that of clearing the ground and preparing the means for carrying forward researches in its field. Work in geology is already largely organized through the Federal State services and involves expenditures which are chiefly met by official funds, with the result that the work of the division differs from that of most of the other divisions which are engaged in coordinating or promoting systematic research.

The work of the division may be grouped under four heads:

(1) *Cooperation with Government agencies.*—The division has cooperated with the interdepartmental conferences for improving the map-making machinery of the Government, and has in preparation, in cooperation with other outside agencies, suggestions for the consideration of the board of surveys, when the latter is established.

The division has also cooperated with the Congressional Committee on Reclassification and with the Bureau of Efficiency by securing information regarding the salary and additional profesional income of geologists connected with universities and State geological surveys throughout the country.

(2) *Educational agencies.*—The division has endeavored to assist universities by finding out what Federal bureaus distribute maps of service in teaching and the conditions under which this distribution

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may be brought about. It has also in progress the study of instruction now being given in geology and geography in the various universities of the country. Through its committee of five geographers, it is about to undertake a campaign to increase the opportunities for the study of geography along modern lines.

(3) *Survey of the field.*—To eliminate duplication of work and delay in supplying information, the division has undertaken to survey the general field of work now in progress in geology among the unorganized investigators and by the State geological surveys. The facts thus far gathered indicate that relatively little research in pure science is done by most of the State surveys, and that the investigations conducted by individuals are largely of a local character. The information thus acquired has enabled the division to bring together students interested in similar subjects, to stimulate enthusiasm by putting younger workers in contact with those who have acquired authoritative positions in their fields, and encouraging those whose opportunities for work are circumscribed.

The division has prepared an extensive biographical catalogue covering those who have been, or are now, active in developing information regarding the geology and geography of the country. From this information, it has been possible to supply the necessary facts regarding individuals to those in search of assistance along specific lines.

(4) *Promotion of special projects.*—Numerous projects have been proposed at the meetings of the division or the executive committee, and the suggestions are being carefully studied, but none has as yet reached the stage of final formulation.

XI. Division of Medical Sciences.

Henry A. Christian, *Chairman.*

The division in its new form was organized on June 9, 1919. For personnel see Appendix A.

It has been organized with a composition of representatives of 12 national societies and 11 members at large. The societies selected are significant of the purposes of the division; they are the national organizations of those branches of medical science fundamental to applied medicine or the practice of medicine, surgery, and the specialties; the societies of the anatomists, pathologists, and bacteriologists, physiologists, pharmacologists, and biochemists. With these are included the American Neurological Association, the American Surgical Association, the American Society for Clinical Investigation, the Association of American Physicians, the American Roentgen Ray Society, and the National Dental Association. The members at large include a representative from each of the Government bureaus dealing with medicine, the Medical Departments of

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the Army and Navy and Public Health Service, and a group of men who in civil capacities are active contributors to medical science. This selection of members stresses the broad biological aspects of medical science but includes representation of the application of medical science to the clinical fields of medicine. This distribution of representatives is an actual index of the character to-day of American medical science.

Two meetings of the division and one of the executive committee have been held. Plans have been made for furthering investigation in several fields, and in most of these active cooperation with other divisions of the National Research Council is an integral part of the project.

The most important consideration of the division is that which concerns all other divisions of the National Research Council, namely, provision of funds for financing the investigative activities of the division. Much thought has been given to this problem, and progress has been made toward a solution of it.

During the last six months there has been published the report of Dr. Roger G. Perkins on "Munitions in France"; the psychological study of Army medical officers has been nearly completed for publication; the investigation of the action of pressure waves due to large guns has been completed by Prof. Dayton C. Miller, and regular reports have been received from Prof. Kofoid on his studies of intestinal parasites in returned soldiers. These all represent activities undertaken under the auspices of the medical section of the National Research Council as organized under the Council of National Defense.

Committees have been appointed to study and report on the following problems:

Improved facilities for publication and indexing in the fields of medical science; investigation of the therapeutic activity of chaulmoogra oil in leprosy; study and classification of the anerobic group of bacteria; problems of health in relation to industry; development of industrial physiology; borderland problems for cooperative investigation of physicists and medical men; cooperation in a biological survey of tropical America, with especial reference to the problems of tropical disease and tropical hygiene; investigation of the present situation in regard to assistants in the departments of the preclinical sciences and its bearing on medical investigation and teaching; provision for a source of rare chemicals and dyes needed in research; establishment of a bureau of technical methods.

During the summer Dr. W. S. Thayer, of Baltimore, and Dr. Charles L. Gibson, of New York, represented the division at a conference in Brussels which resulted in the organization of an inter-

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national biological union with medical sciences as a constituent section thereof, and the division of medical sciences will cooperate in furtherance of these organizations.

XII. Division of Biology and Agriculture.

C. E. McClung, *Chairman.*

The division was organized April 14, 1919. For personnel, see Appendix A.

The early part of the year was largely devoted to the termination of the work of the war-time committees and to the discussion of plans for permanent organization in times of peace. The plans of the division comprise (*a*) a careful and comprehensive survey of the whole field of the division's activities and (*b*) the intensive study of a few immediately pressing problems. The ultimate purpose of such planning is to make biology and agriculture of the greatest possible service to the country and to the world. It is hoped to accomplish this purpose (1) by securing better educational representation of these subjects in the schools, (2) by providing improved conditions for the development of the young investigator, (3) by securing the best and widest opportunities for the proved investigator in attacking the problems of greatest importance, and (4) by establishing the best means for the preservation and distribution of the results of investigation.

A number of the projects has been carried over from the war-time organization, and will be continued so far as possible until satisfactory results have been obtained. In general, these projects relate to future production, conservation, and distribution, and have been carried out in cooperation with government and institutional agencies.

The division has recently taken the following actions:

(1) Provision has been made for a publication board, to study the conditions surrounding biological publication and bibliography and to effect improvements in them.

(2) The Wistar Institute of Anatomy and Biology has been chosen as the organization through which to work in connection with the development of publication and bibliography.

(3) The Marine Biological Laboratory at Woods Hole has been indorsed as an outstanding example of a successful organization for cooperative scientific work conducted on democratic principles by the workers themselves. The division has also committed itself to assist so far as possible in the raising of funds for this laboratory.

(4) A system of research fellowships for biologists has been approved.

(5) The work of the American Phyto-pathological Society has been indorsed.

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(6) On request of the Rockefeller Foundation, an investigation and report has been made upon a project of the Brooklyn Botanic Garden, involving an extensive research program.

(7) A careful study has been initiated regarding a comprehensive biological survey of tropical America by expeditions and by laboratory studies.

(8) A representative forestry committee has been established to study comprehensive problems requiring cooperative effort.

(9) A large representative food and nutrition committee has been appointed to investigate fundamental problems in these fields. This committee has already made substantial progress both in the securing of funds for its work and in the formulation of a program.

(10) The work of a special committee conducting a cooperative study of the salt requirements of certain plants of economic interest has been continued.

(11) The war-time committee on fertilizers has also been continued.

(12) An advisory board for the Institute of Baking has been appointed.

(13) A committee has been appointed to secure cooperation between the different biological agencies of the country. It is actively at work in the national societies, and has begun with the departments of the Federal Government.

(14) A committee has been chosen to review the field, and to prepare lists of current problems of great importance for presentation to the agencies capable of carrying on the necessary investigations.

(15) A committee has been appointed to consider the form and character of the work carried on by educational institutions in the preparation of investigators.

(16) A committee on oceanography has been selected to make a cooperative survey of ocean life.

(17) An organization committee has been chosen to study the problems of climatology.

XIII. Division of Anthropology and Psychology.

Walter VanDyke Bingham, *Chairman.*

The division of anthropology and psychology was organized October 20, 1919. Difficulties experienced by one of the constituent associations in electing its representatives greatly delayed the matter. At the organizing meeting tentative definitions of policy were formulated. For personnel, see Appendix A.

The chairman assumed his duties on November 17. Since that date, progress has been made in getting in touch with research

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undertakings and in assembling proposals for the consideration of the division. At a second meeting of the division, held in Cambridge, Mass., December 30, the following committees were appointed in response to requests from the Surgeon General and from the Division of Education and Recreation of the General Staff of the War Department for counsel in formulating plans regarding the scope, functions, and permanent form of organization of the psychological service in the Army. An advisory committee was named, consisting of Walter D. Scott, of the Scott Co., Philadelphia, Pa., chairman; Maj. G. F. Arps, of the University of Ohio; and Maj. C. S. Yoakum, of the Carnegie Institute of Technology. This committee has already been in conference at Camp Taylor with Gen. Haan, head of the War College, the war plans committee on tests and standards, and other officers working out the future Army program of military and industrial training.

A committee on anthropological and psychological study of the people of the United States has been appointed with W. V. Bingham as chairman.

A committee to formulate a program of research on accumulated Army data has been provided with Dr. R. M. Yerkes as chairman.

Finally a committee on specific projects outside the United States was appointed, with Dr. J. Walter Fewkes, of the Smithsonian Institution, chairman.

As an illustration of incidental but important services rendered by the division to research enterprises may be mentioned the arranging of conferences between Dr. J. B. Watson, Dr. S. I. Franz, Dr. C. B. Davenport, and the physicians in charge of the work of the Diet Kitchen Association of Washington. It is proposed to utilize the facilities of this association for gathering research data, not only on problems of nutrition and growth, but also on important questions of infant psychology, anthropology, and eugenics.

The division has also concerned itself with the problem of improving the conditions of abstracting in psychological literature, improving facilities for prompt publication of major researches, particularly in anthropology, and with the development of an adequate supply of competent research personnel.

The committee on intelligence tests for elementary schools (Dr. M. E. Haggerty of the University of Minnesota; Dr. L. M. Terman, of the Leland Stanford Junior University; Dr. E. L. Thorndike, Teachers' College, Columbia University; Dr. G. M. Whipple, University of Michigan; and Dr. R. M. Yerkes, chairman), referred to by the chairman of the council earlier in this report, has carried on its work with great energy. Although the committee was selected before the

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organization of the division of anthropology and psychology, its work stands in such close relation to that of the latter that it may be appropriately mentioned at this point.

Methods tentatively formulated during the spring of 1919, were given thorough trial in the schools of several parts of the country during May and June. More than 5,000 children in grades 3 to 8 were examined. The majority of these children were given 20 different tests.

During the summer the results of these examinations were analyzed and treated statistically, in order that measurements of reliability and relationship might be made available, to be used as partial basis for selection of the more valuable tests for further use.

The committee met in Washington, October 17 and 18, and in the light of the varied sorts of information available decided to construct two short scales for the measurement of intelligence in elementary schools, grades 3 to 8. These two scales, which may be designated as scale A and scale B, are constituted of five tests each, as follows:

Tests of Scale A.	Tests of Scale B.
Arithmetical reasoning.	Computation.
Sentence completion.	Information.
Logical selection.	Vocabulary.
Synonym-antonym.	Analogies.
Symbol-digit.	Comparison.

Either of these scales may be used alone, but the committee expects to recommend reexamination by the second scale after an interval of at least one day, in order that the reliability of the intelligence measurement may be increased. It is deemed preferable by the committee to use two short scales in the way suggested, rather than to use a single longer scale, the application of which would require approximately an hour of continuous work. Examination by either of the proposed scales A or B will require approximately 30 minutes.

Materials have been prepared by the committee for 10 alternative forms of each of the 10 tests which have been selected for use, but it is planned to complete for immediate publication only five forms of each test and of each scale. The remaining materials will be held subject to later development as needed.

The committee has formulated a general plan for the completion of its principal task, with the expectation that the scales designated above will be ready for general use early in 1920.

James R. Angell,
Chairman.

December 31, 1919.

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APPENDIX A.

DIVISIONS.

Division of General Relations:
- I. Government Division.
- II. Division of Foreign Relations.
- III. Division of States Relations.
- IV. Division of Educational Relations.
- V. Division of Research Extension.
- VI. Research Information Service.

Divisions of Science and Technology:
- VII. Division of Physical Science.
- VIII. Division of Engineering.
- IX. Division of Chemistry and Chemical Technology.
- X. Division of Geology and Geography.
- XI. Division of Medical Sciences.
- XII. Division of Biology and Agriculture.
- XIII. Division of Anthropology and Psychology.

OFFICERS.

Honorary chairman, George E. Hale, director Mount Wilson Observatory, Carnegie Institution of Washington, Pasadena, Calif.

Chairman, James R. Angell, dean of the faculties of arts, literature, and science and head of the department of psychology, University of Chicago, Chicago, Ill.

First vice chairman, Charles D. Walcott, secretary of the Smithsonian Institution and president of the National Academy of Sciences, Washington, D. C.

Second vice chairman, Gano Dunn, president the J. G. White Engineering Corporation, 43 Exchange Place, New York City.

Third vice chairman, R. A. Millikan, professor of physics, University of Chicago, Chicago, Ill.

Secretary, Vernon Kellogg, professor of entomology and lecturer in bionomics, Leland Stanford Junior University, Stanford University, Calif.

Treasurer, F. L. Ransome, geologist, United States Geological Survey, treasurer of the National Academy of Sciences, Washington, D. C.

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President of the American Association for the Advancement of Science, L. O. Howard, Chief Bureau of Entomology, United States Department of Agriculture, Washington, D. C.

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Chairmen of the Divisions of General Relations.

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Van. H. Manning, Director United States Bureau of Mines, Washington, D. C.

R. A. Millikan, professor of physics, University of Chicago, Chicago, Ill.

A. A. Noyes, professor of theoretical chemistry and director research laboratory of physical chemistry, Massachusetts Institute of Technology, Cambridge, Mass.

Raymond Pearl, professor of biometry and vital statistics, the Johns Hopkins University, Baltimore, Md.

M. I. Pupin, professor of electro-mechanics, Columbia University, New York City.

S. W. Stratton, Director United States Bureau of Standards, Washington, D. C.

C. P. Townsend, patent attorney, Washington, D. C.

William H. Welch, director school of hygiene and public health, the Johns Hopkins University, Baltimore, Md.

R. S. Woodward, president the Carnegie Institution of Washington. Sixteenth and P Streets NW., Washington, D. C.

Stated meetings of the executive board of the National Research Council are held on the second Tuesday of each month.

A. DIVISIONS OF GENERAL RELATONS.

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Secretary ex officio, R. M. Yerkes, chairman of the Research Information Service, National Research Council.

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Asst. Surg. Gen. J. W. Schereschewsky, Public Health Service.

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Maj. Gen. William L. Sibert, Chemical Warfare Service, United States Army.

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John T. Creighton, Bureau of Investigation.

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K. F. Kellerman, Bureau of Plant Industry.

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Milton Whitney, Bureau of Soils.

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S. W. Stratton, director, Bureau of Standards.

Hugh M. Smith, Commissioner of Fisheries.

William Bowie, hydrographic and geodetic engineer, Coast and Geodetic Survey.

DEPARTMENT OF LABOR.

Royal Meeker, Commissioner of Labor Statistics.

SMITHSONIAN INSTITUTION.

Charles D. Walcott, Secretary of the Smithsonian Institution.

DIVISION OF FOREIGN RELATIONS.

Chairman, George E. Hale.

Vice chairman, Hon. William Phillips.

Vice chairman, C. E. Mendenhall.

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George E. Hale, foreign secretary, National Academy of Sciences; director Mount Wilson Observatory, Carnegie Institution of Washington, Pasedena, Calif.

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AMERICAN ACADEMY OF ARTS AND SCIENCES.

Arthur A. Noyes, professor of theoretical chemistry and director research laboratory of physical chemistry, Massachusetts Institute of Technology, Cambridge, Mass.

INTERNATIONAL ASTRONOMICAL UNION.

W. W. Campbell,[1] chairman, American committee[2] and vice president of International Astronomical Union; director, Lick Observatory, University of California, Mount Hamilton, Calif.

INTERNATIONAL GEODETIC AND GEOPHYSICAL UNION.

William Bowie,[1] president, Section of Geodesy; chief of division of Geodesy, United States Coast and Geodetic Survey, Washington, D. C.

C. F. Marvin,[1] secretary, Section of Meteorology; chief, United States Weather Bureau, Washington, D. C.

L. A. Bauer,[1] secretary, Section of Terrestrial Magnetism and Electricity; director, Department of Research in Terrestrial Magnetism, Washington, D. C.

G. W. Littlehales,[1] member executive committee, Section of Physical Oceanography; hydographic engineer, United States Hydrographic Office, Washington, D. C.

H. S. Washington,[1] president, Section of Volcanology; Geophysical Laboratory, Washington, D. C.

[1] To serve until representatives of permanent American committees are appointed.
[2] Temporary organization; permanent organization soon to be effected.

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Wilder D. Bancroft, chairman. Division of Chemistry and Chemical Technology, National Research Council, Washington, D. C.

INTERNATIONAL BUREAU OF WEIGHTS AND MEASURES.

S. W. Stratton, member of bureau; director, United States Bureau of Standards, Washington, D. C.

INTERNATIONAL STANDARDIZATION.

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166503°—20—S. Doc. 238, 66-2——8

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8. Committee on paleobotany: Chairman, David White, chief geologist, United States Geological Survey, Washington, D. C.

9. Committee on sedimentation: Chairman, T. Wayland Vaughan, chief, section of coastal plains investigations, United States Geological Survey, Washington, D. C.

10. Committee on Seismology: Chairman, Harry Fielding Reid, professor of dynamical geology and geography, Johns Hopkins University, Baltimore, Md.

XI. Division of Medical Sciences.

Chairman, Henry A. Christian.
Vice chairman, R. G. Hussey.

EXECUTIVE COMMITTEE.

Chairman, Henry A. Christian.
Vice chairman, R. G. Hussey.
Simon Flexner.
William H. Howell.
Reid Hunt.
R. M. Pearce.
F. F. Russell.

MEMBERS OF THE DIVISION.

R. G. Hussey, associate in pathology and bacteriology, Rockfeller Institute for Medical Research, New York City.

Representatives of Societies.

AMERICAN ASSOCIATION OF ANATOMISTS.

Clarence M. Jackson, professor of anatomy and director of the department of anatomy, University of Minnesota, Minneapolis, Minn.

AMERICAN ASSOCIATION OF PATHOLOGISTS AND BACTERIOLOGISTS.

Howard T. Karsner, professor of pathology, Western Reserve University, Cleveland, Ohio.

AMERICAN NEUROLOGICAL SOCIETY.

E. E. Southard, professor of neurology, Harvard University; director Boston Psychopathic Hospital, Boston, Mass.

AMERICAN PHYSIOLOGICAL SOCIETY.

W. H. Howell, assistant director, school of hygiene, and professor of physiology, Johns Hopkins University, Baltimore, Md.

AMERICAN ROENTGEN RAY SOCIETY.

Augustus W. Crane, 420 South Rose Street, Kalamazoo, Mich.

AMERICAN SOCIETY FOR CLINICAL INVESTIGATION.

Henry A. Christian, Hersey professor of the theory and practice of physic, Harvard University; physician in chief, Peter Bent Brigham Hospital, Boston, Mass.

AMERICAN SOCIETY FOR EXPERIMENTAL PATHOLOGY.

Peyton Rous, associate member, Rockefeller Institute for Medical Research, department of pathology and bacteriology, New York City.

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AMERICAN SOCIETY FOR PHARMACOLOGY AND EXPERIMENTAL THERAPEUTICS.

Reid Hunt, professor of pharmacology, Harvard University, Boston, Mass.

AMERICAN SOCIETY OF BIOLOGICAL CHEMISTS.

Graham Lusk, professor of physiology, Cornell University Medical College, New York City.

AMERICAN SURGICAL ASSOCIATION.

George W. Crile, professor of surgery, Western Reserve University, Cleveland, Ohio.

ASSOCIATION OF AMERICAN PHYSICIANS.

W. S. Thayer, professor of medicine, Johns Hopkins University, Baltimore, Md.

NATIONAL DENTAL ASSOCIATION.

Thomas B. Hartzell, professor of oral surgery, University of Minnesota, Minneapolis, Minn.

MEMBERS AT LARGE.

David L. Edsall, professor of clinical medicine, and dean, Harvard University Medical School; chief of medical service, Massachusetts General Hospital, Boston, Mass.

Joseph Erlanger, professor of physiology, Washington University, St. Louis, Mo.

Simon Flexner, director of laboratories, Rockefeller Institute for Medical Research, Sixty-sixth Street and Avenue A, New York City.

Frederick P. Gay, professor of pathology, University of California, Berkeley, Calif.

G. C. Hubner, professor of anatomy and director of anatomic laboratories, University of Michigan, Ann Arbor, Mich.

R. M. Pearce, professor of research medicine, University of Pennsylvania, Philadelphia, Pa.

F. F. Russell, colonel, Medical Corps, United States Army, Army Medical School, Washington, D. C.

E. R. Stitt, rear admiral, United States Navy, commanding officer Naval Medical School, Washington, D. C.

V. C. Vaughan, professor of hygiene and physiological chemistry and dean of the medical school, University of Michigan, Ann Arbor, Mich.

William H. Welch, director school of hygiene and public health, Johns Hopkins University, Baltimore, Md.

H. Gideon Wells, professor of pathology, University of Chicago, director Otho S. A. Sprague Memorial Institute, Chicago, Ill.

A representative of the Government division.

LIST OF COMMITTEES.[1]

1. Committee on anatomy: Chairman, C. M. Jackson, professor of anatomy and director of the department of anatomy, University of Minnesota, Minneapolis, Minn.

2. Committee on neurology and psychiatry: Chairman, E. E. Southard, professor of neuropathology, Harvard University; director Boston Psychopathic Hospital, Boston, Mass.

[1] Other committees are to be appointed.

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3. Committee on medical problems of industry: Chairman, H. A. Christian, Hersey professor of the theory and practice of physic, Harvard University; physician in chief, Peter Bent Brigham Hospital, Boston, Mass.

XII. Division of Biology and Agriculture.

Chairman, C. E. McClung.
Vice chairman, L. R. Jones.

EXECUTIVE COMMITTEE.

Chairman, C. E. McClung.
Vice chairman, L. R. Jones.
I. W. Bailey.
F. R. Lillie.
G. R. Lyman.
H. F. Moore.
A. F. Woods.

MEMBERS OF THE DIVISION.

Representatives of Societies.

AMERICAN SOCIETY OF AGRONOMY.

Charles V. Piper, agrostologist in charge, forage crop investigations, Bureau of Plant Industry, Department of Agriculture, Washington, D. C.

AMERICAN SOCIETY OF BACTERIOLOGISTS.

Samuel C. Prescott, professor of industrial microbiology, Massachusetts Institute of Technology, Cambridge, Mass.

BOTANICAL SOCIETY OF AMERICA.

William Crocker, associate professor of botany, University of Chicago, Chicago, Ill.

A. S. Hitchcock, botanist, systematic agrostologist, Bureau of Plant Industry, United States Department of Agriculture, Washingon, D. C.

L. R. Jones, professor of plant industry, University of Wisconsin, Madison, Wis.

AMERICAN SOCIETY OF ECONOMIC ENTOMOLOGISTS.

P. J. Parrott, entomologist, New York Agricultural Experiment Station, Geneva. N. Y.

ECOLOGICAL SOCIETY OF AMERICA.

W. M. Wheeler, professor of economic entomology, Bussey Institution, Harvard University, Forest Hills, Mass.

SOCIETY OF AMERICAN FORESTERS.

Barrington Moore, president, Ecological Society of America, 925 Park Avenue, New York City.

AMERICAN GENETICS ASSOCIATION.

G. N. Collins, Bureau of Plant Industry, United States Department of Agriculture, Washington, D. C.

AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE.

U. P. Hedrick, horticulturist, New York Agricultural Experiment Station, Geneva, N. Y.

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AMERICAN PHYTOPATHOLOGICAL SOCIETY.

George R. Lyman, pathologist in charge, plant diseases survey, Bureau of Plant Industry, United States Department of Agriculture, Washington, D. C.

SOCIETY OF AMERICAN ZOOLOGISTS.

M. F. Guyer, professor of zoology, University of Wisconsin, Madison, Wis.
F. R. Lillie, professor of zoology, University of Chicago, Chicago, Ill.
G. H. Parker, professor of zoology, Harvard University, Cambridge, Mass.

MEMBERS AT LARGE.

I. W. Bailey, professor of forestry, Bussey Institution, Harvard University, Forest Hills, Mass.

Vernon Kellogg, professor of entomology and lecturer in bionomics, Leland Stanford Junior University, Stanford University, Calif.

B. E. Livingston, director of laboratory of plant physiology, Johns Hopkins University, Baltimore, Md.

C. E. McClung, professor of zoology, and director of zoological laboratory, University of Pennsylvania, Philadelphia, Pa.

C. F. Marbut, geologist in charge of soil survey, Bureau of Soils, United States Department of Agriculture, Washington, D. C.

A. G. Mayor, director, marine biological laboratory, Tortugas, via Key West, Fla.

H. F. Moore, deputy commissioner, Bureau of Fisheries, United States Department of Commerce, Washington, D. C.

J. R. Murlin, professor of physiology and director of vital economics, University of Rochester, Rochester, N. Y.

W. H. Osgood, assistant curator of mammalogy and ornithology, Field Museum, Chicago, Ill.

A. F. Woods, president Maryland State College of Agriculture, College Park, Md.

A representative of the Government division.

LIST OF COMMITTEES.

1. Committee to confer with the division of medicine on anatomy (special committee): Chairman, A. F. Woods, president Maryland State College of Agriculture, College Park, Md.

2. Committee on bibliography and publications (standing committee): Chairman, B. E. Livingston, director of laboratory of plant physiology, Johns Hopkins University, Baltimore, Md.

3. Committee on organization and inquiry on climatology: Chairman, I. W. Bailey, professor of forestry, Bussey Institution, Harvard University, Forest Hills, Mass.

4. Committee on cooperation and coordination (standing committee): Chairman, F. R. Lillie, professor of zoology, University of Chicago, Chicago, Ill.

5. Committee on educational relations (standing committee): Chairman, L. R. Jones, professor of plant industry, University of Wisconsin, Madison, Wis. (*a*) Instruction in universities: Special subcommittee, B. M. Davis, botany, professor of botany, University of Pennsylvania, Philadelphia, Pa.; C. E. McClung, zoology, professor of zoology and director of zoological laboratory, University of Pennsylvania, Philadelphia, Pa.

6. Committee on fellowships (organization committee): Chairman, M. F. Guyer, professor of zoology, University of Wisconsin, Madison, Wis.

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7. Committee on fertilizers (special committee): Chairman, J. G. Lipman, director New Jersey Agricultural Experiment Station, New Brunswick, N. J.

8. Committee on food and nutrition: Chairman, J. R. Murlin, professor of physiology and director of vital economics, University of Rochester, Rochester, N. Y. (*a*) Animal nutrition: Standing subcommittee, chairman, H. P. Armsby, Pennsylvania State College, Pa. (*b*) Human nutrition: Standing subcommittee, chairman, J. R. Murlin. (*c*) Protein metabolism in animal feeding: Special subcommittee, chairman, H. P. Armsby.

9. Committee on forestry (organization committee): Chairman, Raphael Zon, United States Forest Service, Washington, D. C.

10. Committee on marine biological laboratory (special committee): Chairman, F. R. Lillie, professor of zoology, University of Chicago, Chicago, Ill.

11. Committee on plant pathology (standing committee): Chairman, G. R. Lyman, pathologist in charge, plant diseases survey, Bureau of Plant Industry, United States Department of Agriculture, Washington, D. C.

12. Committee to secure lists of current biological problems (standing committee): Chairman, G. N. Collins, Bureau of Plant Industry, United States Department of Agriculture, Washington, D. C.

13. Committee on oceanography to cooperate with division of geology and geography: Chairman, H. F. Moore, deputy commissioner, Bureau of Fisheries, United States Department of Commerce, Washington, D. C.

14. Committee on physiological salt requirements of representative cultivated plants (special committee): Chairman, B. E. Livingston, director of laboratory of plant physiology, Johns Hopkins University, Baltimore, Md.

15. Committee on biological investigations in tropical America (organization committee): Chairman, A. S. Hitchcock, botanist, systematic agrostologist, Bureau of Plant Industry, United States Department of Agriculture, Washington, D. C.

XIII. Division of Anthropology and Psychology.

Chairman, W. V. Bingham.

Executive committee.

Chairman, W. V. Bingham.
Franz Boas.[1]
J. W. Fewkes.
W. D. Scott,
C. E. Seashore.

Members of the division.

W. V. Bingham, professor of psychology and director of the division of applied psychology, Carnegie Institute of Technology, Pittsburgh, Pa.

Representatives of Societies.

American anthropological association.

Franz Boas, professor of anthropology, Columbia University, New York City.[1]

Roland B. Dixon, professor of anthropology, Harvard University, Cambridge, Mass.

J. Walter Fewkes, chief, Bureau of American Ethnology, Smithsonian Institution, Washington, D. C.

A. L. Kroeber, curator of anthropology, Museum of Anthropology; professor of anthropology, University of California, Berkeley, Calif.

[1] Resigned.

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Berthold Laufer, curator of anthropology, Field Museum of Natural History, Chicago, Ill.

Clark Wissler, curator of anthropology, American Museum of Natural History, New York City.

AMERICAN PSYCHOLOGICAL ASSOCIATION.

James R. Angell, dean of the faculties of arts, literature, and science, and head of the department of psychology, University of Chicago, Chicago, Ill.

Raymond Dodge, professor of psychology, Wesleyan University, Middletown, Conn.

W. D. Scott, professor of psychology, Northwestern University, Evanston, Ill.; associate director, bureau of personnel research, Carnegie Institute of Technology, Pittsburgh, Pa.

C. E. Seashore, dean of the graduate college and professor of psychology, State University of Iowa, Iowa City, Iowa.

E. L. Thorndike, professor of educational psychology, teachers' college, Columbia University, New York City.

G. M. Whipple, professor of educational research, University of Michigan, Ann Arbor, Mich.

MEMBERS AT LARGE.

S. I. Franz, scientific director, Government Hospital for the Insane, Washington, D. C.

P. E. Goddard, curator of ethnology, American Museum of Natural History, New York City.

Aleš Hrdlička, curator of physical anthropology, American Museum of Natural History, New York City.

L. M. Terman, professor of education, Leland Stanford Junior University, Stanford University, Calif.

A. M. Tozzer, assistant professor of anthropology and curator of middle American archaeology and ethnology, Peabody Museum of American Archaeology and Ethnology, Harvard University, Cambridge, Mass.

Margaret F. Washburn, professor of psychology, Vassar College, Poughkeepsie, N. Y.

A representative of the Government division.

THE RESEARCH FELLOWSHIP BOARD.

A sum, amounting to $500,000 for the period of May 1, 1919, to June 30, 1925, has been pledged to be appropriated by the Rockefeller Foundation to the National Research Council for the maintenance of national research fellowships in physics and chemistry, under the direction of a research fellowship board appointed by the council of the National Academy of Sciences and the executive board of the National Research Council in joint session.

The members appointed on this board serve for a period of five years. With them the chairmen of the divisions of physical sciences and of chemistry and chemical technology, appointed annually, serve in an ex officio capacity.

MEMBERS OF THE BOARD.

Henry A. Bumstead, professor of physics and director of the Sloane Physical Laboratory, Yale University, New Haven, Conn.

Simon Flexner, director of laboratories, Rockefeller Institute for Medical Research, Sixth-sixth Street and Avenue A, New York City.

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George E. Hale, director Mount Wilson Observatory, Carnegie Institution of Washington, Pasadena, Calif.

Elmer P. Kohler, professor of chemistry, Harvard University, Cambridge, Mass.

Robert A. Millikan, professor of physics, University of Chicago, Chicago, Ill.

Arthur A. Noyes, professor of theoretical chemistry and director of the research laboratory of physical chemistry, Massachusetts Institute of Technology, Cambridge, Mass.

EX OFFICIO.

Wilder D. Bancroft, secretary of the board, chairman division of chemistry and chemical technology, 1919–20; professor of physical chemistry, Cornell University, Ithaca, N. Y.

Charles E. Mendenhall, chairman division of physical sciences, 1919–20; professor of physics, University of Wisconsin, Madison, Wis.

FELLOWS.

Fellowships have been awarded to the following persons, who have demonstrated a high order of ability in research, for the purpose of enabling them to conduct investigations at educational institutions which make adequate provision for research in physics and chemistry:

In chemistry: F. R. Bichowsky, Edwin J. Cohn, Axel R. Olson, Warren C. Vosburgh, Emmet K. Carver, Morris Kharasch, and Worth H. Rodebush.

In physics: Ernest F. Barker, Arthur H. Compton, Robert A. Patterson, Albert E. Caswell, Leonard B. Loeb, and George Porter Paine.

APPENDIX B.

ORGANIZATION OF THE NATIONAL RESEARCH COUNCIL.[1]

PREAMBLE.

The National Academy of Sciences, under the authority conferred upon it by its charter, enacted by Congress, and approved by President Lincoln on March 3, 1863, and pursuant to the request expressed in an Executive Order made by President Wilson on May 11, 1918, hereto appended, adopts the following permanent organization for the National Research Council, to replace the temporary organization under which it has operated heretofore.

ARTICLE I.—PURPOSE.

It shall be the purpose of the National Research Council to promote research in the mathematical, physical, and biological sciences, and in the application of these sciences to engineering, agriculture, medicine, and other useful arts, with the object of increasing knowledge, of strengthening the national defense, and of contributing in other ways to the public welfare, as expressed in the Executive Order of May 11, 1918.

ARTICLE II.—MEMBERSHIP.

SECTION 1. The membership of the National Research Council shall be chosen with the view of rendering the Council an effective federation of the principal research agencies in the United States concerned with the fields of science and technology named in Article I.

[1] As amended previous to Dec. 31, 1919.

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SEC. 2. The Council shall consist of—

1. Representatives of national scientific and technical societies;

2. Representatives of the Government, as provided in the Executive Order;

3. Representatives of other research organizations and other persons whose aid may advance the objects of the Council.

ARTICLE III.—DIVISIONS.

SECTION 1. The Council shall be organized in Divisions of two classes:

A. Divisions dealing with the more general relations and activities of the Council;

B. Divisions dealing with related branches of science and technology.

SEC. 2. The initial constitution of the Divisions of the Council shall be as follows:

A. Divisions of General Relations:

I. Government Division.
II. Division of Foreign Relations.
III. Division of States Relations.
IV. Division of Educational Relations.
V. Division of Research Extension.
VI. Research Information Service.

B. Divisions of Science and Technology:

VII. Division of Physical Sciences.
VIII. Division of Engineering.
IX. Division of Chemistry and Chemical Technology.
X. Division of Geology and Geography.
XI. Division of Medical Sciences.
XII. Division of Biology and Agriculture.
XIII. Division of Anthropology and Psychology.

SEC. 3. The number of divisions and the grouping of subjects in Article III, section 2, may be modified by the Executive Board of the National Research Council.

SEC. 4. The Divisions of General Relations shall be organized by the Executive Board of the National Research Council (Article IV, section 2).

SEC. 5. To secure the effective federation of the principal research agencies in the United States, provided for in Article II, a majority of the members of each of the Divisions of Science and Technology shall consist of representatives of scientific and technical societies, chosen as provided for in Article V, section 2. The other members of the Division shall be nominated by the Executive Committee of the Division, approved by the Executive Board of the National Research Council, and appointed in accordance with Article V, section 4.

SEC. 6. The Divisions of the Council, with the approval of the Executive Board, may establish sections and committees, any of which may include members chosen outside the membership of the Council.

ARTICLE IV.—ADMINISTRATION.

SECTION 1. The affairs of each Division shall be administered by a Chairman, a Vice-Chairman, and an Executive Committee, of which the Chairman and Vice-Chairman shall be ex-officio members. The officers and Executive Committee of the Divisions of General Relations shall be appointed by the Executive Board for such periods as may be determined by the Board except that the Foreign Secretary of the National Academy of Sciences shall be ex-officio Chairman of the Division of Foreign Relations. The officers and Executive

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Committee of each of the Divisions of Science and Technology shall be elected by the Division at its annual meeting, and confirmed by the Executive Board.

SEC. 2. The affairs of the National Research Council shall be administered by an Executive Board, of which the officers of the Council, the President and Home Secretary of the National Academy of Sciences, the President of the American Association for the Advancement of Science, the Chairmen and Vice-Chairmen of the Divisions of Science and Technology, and the Chairmen of the Divisions of General Relations shall be ex-officio members. In the absence of the Chairman of a Division of General Relations, the Vice-Chairman or other Executive Officer shall represent him. The Council of the National Academy of Sciences and the Executive Board of the National Research Council, meeting in joint session, may nominate additional members, not to exceed 12 in number, who, if not already members of the National Research Council, shall be appointed thereto, in accordance with Article V, section 4. Chairmen of the National Research Council, upon their retirement, shall continue as members of the Executive Board for two years beyond the period of their appointment.

SEC. 3. The officers of the National Research Council shall consist of a Chairman, one or more Vice-Chairmen, a Secretary, and a Treasurer, who shall also serve as members and officers of the Executive Board of the Council.

SEC. 4. The officers of the National Research Council, excepting the Treasurer, shall be elected annually by the Executive Board. The Treasurer of the National Academy of Sciences shall be ex-officio Treasurer of the National Research Council.

SEC. 5. The duties of the officers of the Council and of the Divisions shall be fixed by the Executive Board.

ARTICLE V.—NOMINATIONS AND APPOINTMENTS.

SECTION 1. The Government bureaus, civil and military, to be represented in the Government Division, and the scientific and technical societies, to be represented in the Divisions of Science and Technology of the National Research Council, shall be determined by joint action of the Council of the National Academy of Sciences and the Executive Board of the National Research Council.

SEC. 2. Representatives of scientific and technical societies shall be nominated by the societies, at the request of the Executive Board, and appointed by the President of the National Academy of Sciences to membership in the Council and assigned to one of its Divisions.

SEC. 3. The representatives of the Government shall be nominated by the President of the National Academy of Sciences after conference with the Secretaries of the Departments concerned, and the names of those nominated shall be presented to the President of the United States for designation by him for service with the National Research Council.

SEC. 4. Other members of the Council shall be nominated by the Executive Committees of the Divisions, approved by the Executive Board, and appointed by the President of the National Academy of Sciences to membership and assigned to one of the Divisions.

SEC. 5. Prior to the first annual meeting of the Council following January 1, 1919, all Divisions shall be organized by appointment of their members in accordance with Article II and Article V, sections 1 to 4.

SEC. 6. As far as practicable one-third of the original representatives of each scientific and technical society, and approximately one-third of the other original members of each of the Divisions of Science and Technology, shall serve for a term of three years; one-third for a term of two years; and one-third for a term of one year, their respective terms to be determined by lot. Each

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year thereafter, as the terms of members expire, their successors shall be appointed for a period of three years.

SEC. 7. As far as practicable a similar rotation shall be observed in the appointment of the members of the Divisions of General Relations.

SEC. 8. The Government representatives shall serve for periods of three years, unless they previously retire from the Government office which they represent, in which case their successors shall be appointed for the unexpired term.

ARTICLE VI.—MEETINGS.

SECTION 1. The Council shall hold one stated meeting, called the annual meeting, in April of each year, in the city of Washington, on a date to be fixed by the Executive Board. Other meetings of the Council shall be held on call of the Executive Board.

SEC. 2. The Executive Board and the Divisions shall hold annual meetings, at which, in the case of the Divisions of Science and Technology, officers shall be elected; such other meetings may be called as may be required for the transaction of business. The annual meeting of the Executive Board shall be held in April in the city of Washington.

SEC. 3. Joint meetings of the Executive Board of the National Research Council and the Council of the National Academy of Sciences shall be held from time to time, to consider special requests from the Government, the selection of organizations to be represented in the National Research Council, and other matters which, in the judgment of the President of the National Academy, require the attention of both bodies.

ARTICLE VII.—PUBLICATIONS AND REPORTS.

SECTION 1. An annual report on the work of the National Research Council shall be presented by the Chairman to the National Academy of Sciences, for submission to Congress in connection with the annual report of the President of the Academy.

SEC. 2. Other publications of the National Research Council may include papers, bulletins, reports, and memoirs, which may appear in the Proceedings or Memoirs of the National Academy of Sciences, in the publications of other societies, in scientific and technical journals, or in a separate series of the Research Council.

ARTICLE VIII.—AMENDMENTS.

SECTION 1. Power of amendment of these Articles of Organization shall reside in the Council of the National Academy of Sciences.

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ANNUAL REPORT OF THE TREASURER.

JANUARY 1 TO DECEMBER 31, 1919.

To the PRESIDENT OF THE NATIONAL ACADEMY OF SCIENCES:

I have the honor to submit the following report as treasurer of the Academy for the fiscal and calendar year January 1 to December 31, 1919, and as treasurer of the National Research Council for the same period, although the fiscal year of the Research Council, inherited from its wartime connection with the Government, runs from July 1 to June 30. My predecessor in office, Dr. Whitman Cross, continued to act as treasurer up to May 10, and the present report consequently covers a short period anterior to my own induction into office. Opportunity is here taken to express sincere appreciation of the valuable advice and assistance received from Dr. Cross in connection with my entry upon new duties.

In exercise of the authority conferred at a business session of the Academy on April 29 and confirmed at a joint meeting of the council of the Academy and the executive board of the National Research Council held on April 30, 1919, the treasurer engaged Mr. J. Herbert J. Yule as bursar of the National Academy of Sciences and of the National Research Council. Mr. Yule entered upon his duties on July 1, 1919, and has very efficiently handled all of the details of the accounting for both organizations. The financial transactions of the Research Council have increased so greatly as to occupy by far the greater part of Mr. Yule's time and the results of the change from the former divided responsibility for the accounting have fully justified his appointment. All checks must now bear two signatures. Normally they are signed by the bursar and countersigned by the treasurer, but provision has been made whereby, in the absence of one or both of these officers, the president of the Academy, the chairman of the National Research Council, or both, may sign in place of one or both of the usual signers.

In accordance with the legal opinion presented by the president of the Academy to a meeting of the council of the Academy on November 9, 1919, the treasurer has interpreted his duties under the decision that the National Research Council is an organic part or department of the National Academy of Sciences, and that there is but one legal entity, the corporation known as the National Academy of Sciences.

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Under this ruling, all funds for the use of the Research Council, although carried separately on the books in appropriate accounts, are deposited in bank to the credit of the National Academy of Sciences and checks drawn thereon are countersigned by the treasurer as an officer of the Academy, and not as an officer of the Research Council. In conformity to this view, the present report is divided into two parts, the first covering the financial transactions of the Academy proper and the second those of the Research Council. In this, the form of presentation departs in some respects from an inherited bookkeeping procedure that was a natural consequence of the war-time development of the Research Council, and which has necessarily been adhered to, in part, during 1919.

NATIONAL ACADEMY OF SCIENCES.

The total income of the Academy from gifts, dues, interest on investments and bank deposits, subscriptions and contributions to the Proceedings, contributions for the building site, and the William Ellery Hale lectureship, was $247,372.22. This sum does not include uninvested funds in active use for the current support of the National Research Council. These are elsewhere accounted for. The miscellaneous disbursements amounted to $240,751.29, and payments on grants from trust funds and for medals amounted to $7,777.48.

The total book value of investments held by the Academy on December 31 was $267,904.75, yielding interest at that date at the rate of 5.2 per cent. The market value of these investments as nearly as could be determined on December 31 was $247,674, and the interest rate as computed on that sum was 5.62 per cent. Attention is called to the difference, amounting to $20,230.75, between the book value of the Academy's investments and the market value, as shown on pages 135 to 137. This shrinkage of 7½ per cent does not, it is believed, warrant any concern as to the ultimate value of the security behind bonds of the class owned by the Academy. It is mainly a consequence of the present currency inflation which has lessened the purchasing power of the dollar and is leading investors in fixed-income securities to demand a higher interest return than formerly.

Unless, however, prices fall within the next few years, the Academy will have suffered a very considerable real loss in its investments, both in mortgage notes and in bonds, through the redemption of these securities in coin or currency of a lower purchasing power than obtained when the securities were bought. Under the condition of rising prices that has prevailed for the past 20 years, and particularly for the past 5 years, the tradition that trust funds must be invested in fixed-income securities such as mortgages and bonds, while insuring nominal safety, has unfortunately resulted in an ac-

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tual loss to the investor which, in a long-term investment, may have consumed not only his interest but a large part of his principal. The investor gets back the thousand dollars that he originally invested, but finds that these dollars, measured in terms of what they will buy for him in the necessities or pleasures of life, are really worth only a half or a third of what they were when he loaned them. The return of his principal with interest is apparent: the loss is real. The investor of trust funds to-day is confronted not so much with the question, "How can I invest this sum so as to bring the highest return with safety?" as "How can I invest this so as to incur the least loss?"

Changes in investments during the year may be summarized as follows: Loans on real estate aggregating $39,500 were paid, and accrued interest on one of these loans for 1917 and 1918, amounting to $1,500, was collected. One real estate note for $5,000 was renewed for three years at an increased rate of interest. Six bonds, of the total face value of $6,000, were called for retirement and redeemed; eight bonds of the total face value of $8,000 were exchanged for others of the same face value, regarded as better securities: additional bonds of the total face value of $48,000 were purchased for $46,520.

In accordance with the action of the Academy in November, 1916, the capital of the Marsh fund was increased to $19,500 through the transfer of $500 from income. By the addition of another increment of $500, this fund on February 1, 1920, will reach the total of $20,000 authorized by the Academy.

A gift of $10,000 was received from Mrs. Mary Clark Thompson for the establishment of a fund from which the income is to be applied to the annual award of a gold medal, to be known as the Mary Clark Thompson gold medal, for the most important services to geology and paleontology. The gift was made in the form of one $10,000 United States third Liberty loan 4¼ per cent registered gold bond which has been retained as the investment of the fund. Mrs. Thompson also gave $1,000 to defray the cost of the designs and dies for the medal.

The consolidated investment fund reached a total of $183,645.50 by additions during the year to the Marsh and Billings funds.

As the capital of the trust funds of the Academy is fixed by the terms of gift or by action of the Academy, and as the value of any fund invested in bonds must vary with the market and consequently any sale or exchange of securities held by the Academy will normally result in some increase or decrease of the capital invested, the following action, at the suggestion of the treasurer, was taken at a meeting of the council of the Academy held on November 9.

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Moved: That in case of any sale or exchange of investment securities the treasurer be and is hereby authorized to transfer any profit from such transaction from the capital to the income of the fund concerned or to make good any loss of capital by a corresponding transfer from income to capital. If the securities sold or exchanged represent part of the consolidated fund, then such gain or loss in capital is to be apportioned in the same manner as prescribed for income in Article VI, section 1, of the constitution, and the necessary transfers then made from income to capital, or vice versa, to restore the capital of each fund to the figure at which it stood prior to the change in securities.

Adopted.

During the year contributions in cash amounting to $141,100 were received toward the purchase of a building site for the Academy and the Research Council. In addition one contribution for the same purpose was made in bonds of the face value of $10,000, but of as yet undetermined real value. A site has been purchased at a cost, to December 31, 1919, of $185,010.21, this sum covering all payments to be made for the land itself. In order to effect this purchase it was necessary on November 19 to negotiate a loan of $40,000 based on securities approximately equal in value to the invested capital of the Agassiz fund and the building fund of the Academy. This loan has since been in part paid off as previously pledged subscriptions have come in, and other contributions already subscribed are expected soon to extinguish it entirely. It is the intention to convert the original building fund of the Academy, amounting on December 31 to $10,290.36, of which $9,400 is invested, into cash, by the transfer of bonds to other funds in which there is money to invest, and to apply this cash, or so much of it as may be necessary, to the purchase of the building site.

TRUST FUNDS OF THE ACADEMY.

The trust funds of the Academy, the income of which is administered for specific purposes, are enumerated below. The capital of certain funds has been increased beyond the amount of the original gift or bequest by the transfer of accumulated income at the request of the donors or by action of the Academy.

Bache fund: Bequest of Alexander Dallas Bache, a member of the Academy, 1870. To aid researches in physical and natural sciences	$59,000.00
Watson fund: Bequest of James C. Watson, a member of the Academy, 1874. For the promotion of astronomical science through the award of the Watson gold medal and grants of money in aid of research	25,000.00
Draper fund: Gift of Mrs. Henry Draper, 1883. In memory of her husband, a former member of the Academy. To found the Henry Draper gold medal, to be awarded for notable investigations in astronomical physics. The balance of income is applied to aid research in the same science	10,000.00

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Smith fund: Gift of Mrs. J. Lawrence Smith, 1884, in memory of her husband, a former member of the Academy. To found the J. Lawrence Smith gold medal, to be awarded for important investigations of meteoric bodies and to assist, by grants of money, researches concerning such objects	$10,000.00
Gibbs fund: Established by gift of Wolcott Gibbs, a member of the Academy, 1892, and increased by a bequest of the late Morris Loeb, 1914. For the promotion of researches in chemistry	5,545.50
Gould fund: Gift of Miss Alice Bache Gould, 1897, in memory of her father, a former member of the Academy. For the promotion of researches in astronomy	20,000.00
Comstock fund: Gift of Gen. Cyrus B. Comstock, a member of the Academy, 1907. To promote researches in electricity, magnetism, or radiant energy through the Comstock prize of money, to be awarded once in five years for notable investigations. The fund is to be increased ultimately to $15,000	12,406.02
Marsh fund: Bequest of Othniel Charles Marsh, a member of the Academy, 1909. To promote original research in the natural sciences. To the original bequest of $10,000 the Academy has added interest received from the estate and has authorized the increase of the fund to $20,000 by annual additions from income	19,500.00
Murray fund: A gift from the late Sir John Murray, 1911, to found the Alexander Agassiz gold medal, in honor of a former member and president of the Academy, to be awarded for original contributions to the science of oceanography	6,000.00
Hartley fund: A gift from Mrs. Helen Hartley Jenkins, 1913–14, in memory of her father, Marcellus Hartley, to found the medal of the Academy awarded for eminence in the application of science to the public welfare	1,200.00
Billings fund: Established by the bequest of Mrs. Mary Anna Palmer Draper (Mrs. Henry Draper) of $25,000, 1915. To support the publication of the proceedings of the Academy or for other purpose, to be determined by the Academy. Three installments	5,000.00
Elliot fund: Gift of Margaret Henderson Elliot to found the Daniel Giraud Elliot gold medal and honorarium for the most meritorious work in zoology or paleontology published in each year	8,000.00
Thompson fund: Gift of Mrs. Mary Clark Thompson, 1919, the income thereof to be applied for a gold medal of appropriate design to be awarded annually by the Academy for the most important services to geology and paleontology; the medal to be known as the Mary Clark Thompson gold medal	10,000.00
In addition to the above-named funds the Academy holds the following:	
Agassiz fund: Bequest of Alexander Agassiz, a member of the Academy, 1910, for the general uses of the Academy	50,000.00
Building fund: A gift from Alexander Agassiz and Theodore N. Gill, former members of the Academy, toward a building for the Academy	9,400.00
Total	251,051.52

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STATEMENT OF ASSETS AND LIABILITIES, DEC. 31, 1919.

ASSETS.

	Face value.	Book value:[1]	Market value, Dec. 31, 1919.[2]
1. Mortgage notes, secured by first mortgages on real estate.....	$40,500.00	$40,500.00	$40,500.00
BONDS.			
2. [Bonds purchased or donated during the year are indicated thus *.]			
American Telephone & Telegraph Co., 30-year, 5 per cent, gold collateral trust, due Dec. 1, 1946: Nos. 640, 4604, 29245, 29246, 41419; 5 at $1,000.....	5,000.00	4,752.50	3,975.00
Asheville Power & Light Co., first mortgage, 30-year gold, 5 per cent, due Apr. 1, 1942, New York; Nos. 272, 490, 492, 508, 509; 5 at $1,000..	5,000.00	4,892.50	4,000.00
Broadway Realty Co., purchase money, first 5 per cent gold, due Sept. 1, 1926; Nos. 38, 50, 796, 963, 964, 965, 1068, 1616 to 1620; 12 at $1,000.....	12,000.00	12,345.00	10,920.00
Bush Terminal Buildings Co., first mortgage 50-year sinking fund, 5 per cent gold, due Apr. 1, 1960; Nos. 1383–1387 and 2805–2809; 10 at $1,000.....	10,000.00	9,375.00	8,062.00
Chesapeake & Ohio, general mortgage, 4.5 per cent gold, due New York, Mar. 1, 1992; Nos. 15350–15354; 5 at $1,000.....	5,000.00	4,600.00	3,731.00
City of Tacoma, Green River special water fund No. 2; 5 per cent due Oct. 1, 1939; Nos. 1508–1511; 4 at $1,000.....	4,000.00	4,140.00	3,640.00
Cleveland Electric & Illuminating Co., first mortgage, 5 per cent gold, due New York, Apr. 1, 1939; Nos. D261–D264, 4 at $500, and Nos. M6060, M6096, M6097, M15094–15098; 8 at $1,000.....	10,000.00	9,597.50	8,700.00
*Commonwealth Electric Co., first 5 per cent, due June 1, 1943; Nos. 2945–2947, 4011; 4 at $1,000.....	4,000.00	3,600.00	3,400.00
Cosmos Club, 4.5 per cent, due July 1, 1949; Nos. 286–289, 290–294, 296, 297, 299, 301, 303–305. 350; 17 at $1,000.....	17,000.00	17,000.00	13,906.00
Detroit Edison Co., first and refunding, mortgage, gold, 5 per cent, due Jan. 1, 1940; Nos. 9657–9660, 4 at $1,000, and Nos. D501, D502, D599; 3 at $500.....	5,500.00	5,005.00	4,895.00
Detroit Edison Co., first mortgage, 30-year gold, 5 per cent, due Jan. 1, 1933; Nos. 557, 2442, 2443, 3024. 3252, 3253, 3639–3641, 8086; 10 at $1,000.....	10,000.00	10,072.50	9,500.00
Dominion Coal Co. (Ltd.), first mortgage, sinking fund, gold, 5 per cent, due New York, May 1, 1940: Nos. A1037–A1040; 4 at $1,000..	4,000.00	3,625.00	3,280.00
Galveston, Harrisburg & San Antonio, Mexican and Pacific Ex., 6 per cent, second guaranteed, reduced to 5 per cent, due Jan. 1, 1931; Nos. 1044, 1048, 1248, 2112–2116; 8 at $1,000.....	8,000.00	8,030.00	7,680.00
Georgia Ry. & Electric Co., first consolidated mortgage, 5 per cent, sinking fund gold, due Jan. 1, 1932; Nos. *191, 1061, 1600; 3 at $1,000.	3,000.00	2,995.00	2,610.00
Government of the Province of Alberta, 4.5 per cent, 10-year gold debenture, due New York, Dec. 1, 1923: Nos. 1501–1511; 11 at $100, and Nos. 2031, 2032; 2 at $500.....	2,100.00	2,008.50	1,911.00
Government of the Province of Alberta, 4.5 per cent, 10-year gold debenture, due New York, Feb. 1, 1924; No. 2620; 1 at $500.....	500.00	480.00	455.00
Government of the Province of Alberta, 5 per cent, 10-year gold debenture, due New York, May 1, 1925; No. 2364, 1 at $1,000, and Nos. O189B–O193B, 5 at $500.....	3,500.00	3,373.75	3,255.00

[1] The book value of bonds held by the academy was originally entered at cost but was modified by appraisement at the time of the formation of the consolidated fund. The policy of the present treasurer is to enter all newly-purchased bonds at cost and to maintain such entry unchanged as the book value until the bonds are redeemed or disposed of.

[2] Based on "bid" quotations of the Commercial and Financial Chronicle of January 3, 1920. In the case of a few bonds that are not quoted on the stock exchanges the market value has been calculated on the basis of 5½ per cent yield.

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Statement of assets and liabilities, Dec. 31, 1919—Continued.

ASSETS—Continued.

	Face value.	Book value.	Market value, Dec. 31, 1919.
BONDS—continued.			
Grand Rapids Gas Light Co., 5 per cent, first mortgage, gold, due New York Aug. 1, 1939; Nos. A522, A523, A595, A596; 4 at $1,000	$4,000.00	$4,020.00	$3,720.00
Hydraulic Power Co. of Niagara Falls, 5 per cent refunding and improvement mortgage, due Oct. 1, 1951; Nos. D457, D458; 2 at $500	1,000.00	890.00	870.00
Liberty, third loan, 4½ per cent gold of 1928; No. *8239, 1 at $10,000; Nos. 1049788–1049800, 1050701–1050712, 25 at $100; and Nos. 1886579–1886588; 10 at $50	13,000.00	13,000.00	12,350.00
Liberty, fourth loan, 4½ per cent gold of 1933–1938; Nos. 2566501, 2566502; 2 at $100	200.00	200.00	184.00
Michigan Northern Power Co., first mortgage guaranteed, 5 per cent, due 1941; Nos. 5054, 5057, 5216, 5567–5571; 8 at $1,000	8,000.00	7,200.00	6,400.00
Milwaukee Electric Ry. & Light Co., 5 per cent general and refunding mortgage gold, series A, due New York, Dec. 1, 1951; Nos. 2088, 2772, 3830, 3840, 3930, 3931, 5222–5224; 9 at $1,000	9,000.00	8,237.50	6,795.00
Minneapolis General Electric Co., 5 per cent 30-year gold mortgage, due New York Dec. 1, 1934; Nos. 1621, 1622, 1949, 2004, 2572–2575, 7579, 7580; 10 at $1,000	10,000.00	9,880.00	9,400.00
Niagara Falls Power Co., first mortgage, 5 per cent, gold, coupon, due Jan. 1, 1932; Nos. 5246, 5247, 6583, 8358; 4 at $1,000	4,000.00	4,100.00	3,670.00
*Niagara Falls Power Co., first mortgage, 5 per cent, gold, registered, due Jan. 1, 1932; No. R484; 1 at $6,000	6,000.00	5,760.00	5,505.00
Riggs Realty Co., 3–30 year coupon, first 5 per cent, due Washington, D. C., Oct. 1, 1940; Nos. 108, 112, 116, 120, 124, 128, 132, 136, 140, 144; 10 at $1,000	10,000.00	10,397.50	9,200.00
Shawinigan Water & Power Co., 5 per cent consolidated mortgage 30-year, gold, due Jan. 1, 1934; Nos. M0354, M0510, M2894, M2943; 4 at $1,000; Nos. D4647, D5337; 2 at $500	5,000.00	4,752.50	4,550.00
Southern Bell Telephone & Telegraph Co., 30-year first mortgage, 5 per cent, sinking fund, gold, due Jan. 1, 1941; Nos. M9739, M11576–M11579, M13965, M15568–M15570; 9 at $1,000	9,000.00	8,942.50	7,560.00
*Trinity Buildings Corporation, first mortgage, gold, 5½ per cent, due 1939; Nos. M5229–M5243; 15 at $1,000, and Nos. D697–D706; 10 at $500	20,000.00	19,900.00	19,900.00
Union Electric Light & Power Co. of St. Louis, 5 per cent first mortgage, 30-year, gold, due New York Sept. 1, 1932; Nos. 1352, 4169, 8601, *3821; 4 at $1,000	4,000.00	3,782.50	3,600.00
*United Kingdom of Great Britain and Ireland, 10-year, 5½ per cent, due Aug. 1, 1929; temporary certificates; 16 at $1,000	16,000.00	15,400.00	15,200.00
Vicksburg, Shreveport & Pacific R. R. Co., prior-lien mortgage at 6 per cent, gold, renewed at 5 per cent, due Nov. 1, 1915, extended to Nov. 1, 1940; Nos. 561, 661, 794, 982, 1323; 5 at $1,000	5,000.00	5,050.00	4,350.00
Total	273,300.00	267,904.75	247,674.00

SUMMARY OF THE ABOVE.

1. Book value of mortgage notes as above	$40,500.00	
2. Book value of bonds as above	227,404.75	
		$267,904.75
3. Bank balance, Dec. 31, 1919	16,922.65	
Less General Education Board, mental rating of school children	3,891.86	
		13,030.79
Total		280,935.54

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Statement of assets and liabilities, Dec. 31, 1919—Continued.

LIABILITIES.

	Income.	Capital.		Income.	Capital.
General fund:			Hartley fund:		
Invested	$3,020.00		Invested		$1,200.00
Uninvested	575.67		Uninvested	$142.13	
Agassiz fund: Invested		$50,000.00	Marsh fund:		
Bache fund:			Invested	150.00	19,500.00
Invested		50,000.00	Uninvested	944.05	
Uninvested	1,685.83		Murray fund:		
Billings fund:			Invested	400.00	6,000.00
Invested	50.00	5,000.00	Uninvested	726.86	
Uninvested	70.84		National Research Council:		
Building fund:			Invested	1,855.00	
Invested	200.00	9,400.00	Uninvested	1,301.73	
Uninvested	690.36		Proceedings: Uninvested	563.79	
Building site: Uninvested			Smith fund:		
(due academy)	3,378.63		Invested	2,032.50	10,000.00
Comstock fund:			Uninvested	1,289.21	
Invested	500.00	12,265.00	Thompson fund:		
Uninvested	903.77	141.02	Invested		10,000.00
Consolidated fund:			Uninvested	1,000.00	
Uninvested	1,568,79		Watson fund:		
Draper fund:			Invested	1,000.00	24,476.25
Invested	1,952.50	10,000.00	Uninvested	992.44	523.75
Uninvested	381.91		Total	29,884.02	251,051.82
Elliot fund:			Total income		29,884.02
Invested	300.00	8,000.00			
Uninvested	419.66		Grand total		280,935.84
Gibbs fund:					
Invested	500.00	5,545.50	Consolidated investment fund:		
Uninvested	352.73		Invested		152,751.00
Gould fund:			Uninvested	1,568.79	894.50
Invested	6,250.00	19,992.50		1,568.79	153,645.50
Uninvested	1,205.39	7.50			
Hale lectureship:					
Invested	200.00				
Uninvested	27.58				

CONDENSED STATEMENT OF RECEIPTS AND EXPENDITURES, JAN. 1 TO DEC. 31, 1919.

RECEIPTS.

Balance, Jan. 1, 1919, as per last report		$14,187.34
Cash receipts:		
Total income from investments	$15,268.62	
Bonds called in and paid	6,090.00	
Mortgage notes paid	89,500.00	
Annual dues	930.00	
Subscriptions	881.46	
Reprints and separate numbers of proceedings	722.42	
Contribution to proceedings	500.00	
Interest on bank deposits	397.55	
William Ellery Hale lectureship	300.00	
Gift from Mrs. Mary Clark Thompson	1,000.00	
Contributions to building site	141,100.00	

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Cash receipts—Continued.		
Interest on bank deposits, building site	$531.58	
Borrowed on collateral, building site	40,000.00	
Refund on Bache fund	6.17	
Refund on Murray fund	2.53	
Refund on National Research Council	35.67	
Contribution of W. W. Keen to National Research Council	106.22	
		$247,372.22
Book transfers:		
Income transfers	1,560.00	
Distribution of income from consolidated	9,902.95	
		11,462.95
Total		273,022.51

EXPENDITURES.

Book transfers:		
Income transfers	$1,560.00	
Distribution of income from consolidated	9,902.95	
		$11,462.95
Cash expenditures:		
Investment of capital	46,520.00	
Accrued interest	283.93	
Adjustment on sale of bonds	616.25	
		47,420.18
Purchase of building site	185,010.21	
Cost of plats and blue prints	25.50	
		185,035.71
Payments from trust and other funds:		
Bache fund—		
A. G. Webster	$1,500.00	
Geo. H. Shull	180.00	
Wayne J. Atwell	105.00	
Duncan S. Johnson	300.00	
C. W. Richmond	558.60	
M. W. Lyon, jr.	343.00	
N. Hollister	65.83	
Max Ellis	15.00	
Carl H. Eigenmann	1,000.00	
H. W. Norris	100.00	
Dr. H. Nort	200.00	
		4,367.43
Draper fund—		
Charles Fabry, medal	212.05	
Frank Schlesinger, grant	400.00	
		612.05
Elliott fund—		
William Beebe, medal	200.00	
Miscellaneous expenses	5.00	
		205.00
Gould fund, Astronomical Journal		500.00
Hale lectureship, honorarium		300.00
Marsh fund—		
Roy L. Moodie, grant	200.00	
Ferdinand Canu, grant	250.00	
		450.00

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Payments from trust and other funds—Cont'd.			
Murray fund, Prince of Monaco, medal		$43.00	
Watson fund—			
John A. Miller, grant	$500.00		
Herbert C. Wilson, grant	800.00		
J. A. Parkhurst, grant	500.00		
		1,300.00	
			$7,777.48
Proceedings:			
Salary, managing editor		750.00	
Printing and distributing		2,864.43	
Expenses—			
Boston office		215.00	
Washington office		119.98	
			3,949.41
General fund:			
Salary, assistant secretary and assistant treasurer		600.00	
Treasurer's office		435.40	
Home secretary's office		1,109.35	
Memoirs, printing, etc		1,266.93	
Meeting—			
Annual		696.62	
Autumn		222.69	
Election of members		15.00	
			4,345.99
			259,991.72
Balance, Dec. 31, 1919		16,922.65	
Less General Education Board mental rating of school children (accounted for in section devoted to National Research Council, see p. 147)		3,891.86	
			13,030.79
Total			273,022.51

ACCOUNTS WITH INDIVIDUAL FUNDS JAN. 1 TO DEC. 31, 1919.

	General fund.		Agassiz fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1919:				
Cash	$508.81			
Invested	4,176.25			$50,000.00
Receipts:				
Interest on deposits	397.55			
Interest on investments	2,924.21			
Total	8,006.82			50,000.00
Disbursements:				
General expenses	4,345.99			
Adjustment on sale of bonds	65.16			
Balance Dec. 31, 1919:				
Cash	575.67			
Invested	3,020.00			50,000.00
Total	8,006.82			50,000.00

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Accounts with individual funds Jan. 1 to Dec. 31, 1919—Continued.

	Bache fund.		Billings fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1919:				
Cash	$2,223.98		$1,347.66	
Invested	500.00	$59,000.00	50.00	$3,750.00
Receipts:				
Interest on investments	3,323.11		205.06	
Transfer income to capital				1,250.00
Refund by C. K. Drinker	6.17			
Total	6,053.26	59,000.00	1,602.72	5,000.00
Disbursements:				
Grants	4,367.43			
Transfer income to capital			1,250.00	
Transfer to proceedings			231.88	
Balance Dec. 31, 1919:				
Cash	1,685.83		70.84	
Invested		59,000.00	50.00	5,000.00
Total	6,053.26	59,000.00	1,602.72	5,000.00

	Building fund.		Building site.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1919:				
Cash	$199.63			
Invested	200.00	$9,400.00		
Receipts:				
Subscriptions			$141,100.00	
Loan on collateral			40,000.00	
Loan, National Academy			3,378.63	
Interest on bank deposit			531.58	
Interest on investments	516.23			
Total	915.86	9,400.00	185,010.21	
Disbursements:				
Purchase of site			185,010.21	
Plats and blue prints	25.50			
Balance Dec. 31, 1919:				
Cash	690.36			
Invested	200.00	9,400.00		
Total	915.86	9,400.00	185,010.21	

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Accounts with individual funds Jan. 1 to Dec. 31, 1919—Continued.

	Comstock fund.		Consolidated fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1919:				
Cash	$646.04	$37.27	$1,575.33	$177.09
Invested		12,368.75		181,718.80
Receipts:				
Interest on investments	822.89		10,580.48	
Cash transfer (Marsh)				500.00
Investments transfer (Billings)				1,250.00
Total	1,468.93	12,406.02	12,155.81	183,645.89
Disbursements:				
Accrued interest on bonds purchased			263.30	
Adjustment on sale of bonds	65.16		420.77	
Distribution of income to funds			9,902.95	
Balance Dec. 31, 1919:				
Cash	903.77	141.02	1,568.79	394.89
Invested	500.00	12,265.00		183,751.00
Total	1,468.93	12,406.02	12,155.81	183,645.89

	Draper fund.		Elliot fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1919:				
Cash	$449.30		$182.57	
Invested	1,952.50	$10,000.00	300.00	$8,000.00
Receipts: Interest on investments	544.66		442.09	
Total	2,946.46	10,000.00	924.66	8,000.00
Disbursements: Grants and medals	612.05		205.00	
Balance Dec. 31, 1919:				
Cash	381.91		419.66	
Invested	1,952.50	10,000.00	300.00	8,000.00
Total	2,946.46	10,000.00	924.66	8,000.00

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Accounts with individual funds Jan. 1 to Dec. 31, 1919—Continued.

	Gibbs fund.		Gould fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1919:				
Cash	$44.33		$1,315.96	$7.50
Invested	500.00	$5,545.50	5,255.00	19,992.50
Receipts: Interest on investments	308.40		1,388.56	
Total	852.73	5,545.50	7,959.52	20,000.00
Disbursements:				
Astronomical Journal			500.00	
Accrued interest on bonds purchased			4.13	
Balance Dec. 31, 1919:				
Cash	352.73		1,205.39	7.50
Invested	500.00	5,545.50	6,250.00	19,992.50
Total	852.73	5,545.50	7,959.52	20,000.00

	Hale lectureship.		Hartley fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1919:				
Cash	$23.34		$76.77	
Invested	200.00			$1,200.00
Receipts:				
Interest on investments	4.24		65.36	
Contribution to Hale lectureship	300.00			
Total	527.58		142.13	1,200.00
Disbursements: Honorarium	300.00			
Balance Dec. 31, 1919:				
Cash	27.58		142.13	
Invested	200.00			1,200.00
Total	527.58		142.13	1,200.00

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Accounts with individual funds Jan. 1 to Dec. 31, 1919—Continued.

	Marsh fund.		Murray fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1919:				
Cash	$857.00		$432.05	
Invested	150.00	$19,000.00	400.00	$5,000.00
Receipts:				
Interest on investments	1,037.05		335.28	
Transfer income to capital		500.00		
Refund on charge for medal			2.53	
Total	2,044.05	19,500.00	1,169.86	6,000.00
Disbursements:				
Grants and medal	450.00		43.00	
Transfer income to capital	500.00			
Balance Dec. 31, 1919:				
Cash	944.05		726.86	
Invested	150.00	19,500.00	400.00	6,000.00
Total	2,044.05	19,500.00	1,169.86	6,000.00

	Proceedings' fund.		National Research Council.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1919:				
Cash	$1,247.35		$1,059.84	
Invested			1,865.00	
Receipts:				
Annual dues	930.00			
Subscriptions	881.46			
Reprints and separates	722.42			
Contribution	500.00			
Transfer from Billings fund	231.88			
Interest on investments			100.00	
Contribution of W. W. Keen, third installment			106.22	
Refund			35.67	
Total	4,513.11		3,166.73	
Disbursements:				
Salary, managing editor	750.00			
Printing and distributing	2,864.43			
Expenses, Boston office	215.00			
Expenses, Washington office	119.98			
Balance Dec. 31, 1919:				
Cash	563.70		1,301.73	
Invested			1,865.00	
Total	4,513.11		3,166.73	

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Accounts with individual funds Jan. 1 to Dec. 31, 1919—Continued.

	Smith fund.		Watson fund.	
	Income.	Capital.	Income.	Capital.
Balance, Jan. 1, 1919:				
Cash	$683.95		$1,087.91	$3.75
Invested	2,032.50	$10,000.00	1,103.75	24,996.25
Receipts: Interest on investments	605.26		1,182.44	
Total	3,321.71	10,000.00	3,374.10	25,000.00
Disbursements:				
Grants			1,300.00	
Accrued interest on bonds purchased			16.50	
Adjustment on sale of bonds			65.16	
Balance Dec. 31, 1919:				
Cash	1,289.21		992.44	523.75
Invested	2,032.50	10,000.00	1,000.00	24,476.25
Total	3,321.71	10,000.00	3,374.10	25,000.00

	Thompson fund.	
	Income.	Capital.
Receipts, from Mrs. Mary Clark Thompson:		
Cash	$1,000.00	
Invested		$10,000.00
Total	1,000.00	10,000.00
Balance, Dec. 31, 1919:		
Cash	1,000.00	
Invested		10,000.00
Total	1,000.00	10,000.00

NATIONAL RESEARCH COUNCIL.

The work of the National Research Council during 1919 was supported by funds derived from various sources. The amounts, sources, and general purposes of these funds were in the main as follows:

(1) The sum of $85,000 was received from the Carnegie Corporation of New York through the Carnegie Institution of Washington and $15,000 was received directly from the Carnegie Corporation of New York for the general expenses of maintenance of the National Research Council.

(2) From the Rockefeller Foundation the following amounts were received and disbursed:

For the division of medical sciences the sum of $9,396.95 was received and disbursements for this purpose of $11,943.78 were made.

The sum of $19,680.75 was received for national research fellowships and the sum of $12,222.86 was expended for this purpose.

166503°—20—S. Doc. 238, 66-2——10

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For the division of physical sciences the sum of $9,016.80 was received and disbursements for this purpose amounted to $5,016.80.

(3) From the General Education Board the following amounts were received and disbursed:

For the mental rating of school children the sum of $24,756.47 was received and the sum of $20,865.87 was disbursed for this purpose.

For special work to be carried on by the division of educational relations the sum of $2,500 was received and the sum of $897.56 expended for this purpose.

(4) The sum of $40,274.71 was contributed by the Government through the Council of National Defense and expended for governmental activities of the National Research Council.

The sum of $5,802.84 was received from the Government through the Ordnance Bureau of the War Department, and this same sum was expended for experimental work on a new type of gun.

RECEIPTS AND DISBURSEMENTS OF THE NATIONAL RESEARCH COUNCIL, JAN. 1 TO DEC. 31, 1919.

RECEIPTS.

Balance, reported Jan. 1, 1919		$12,875.76
Carried, Dec. 31, 1918, on the books of the National Academy under the heading "National Research Council":		
Cash uninvested	$1,059.84	
Cash invested	1,865.00	
		2,924.84
		9,950.92
Rockefeller Foundation:		
Medical sciences	9,396.95	
National research fellowships	19,680.75	
Physical sciences	9,016.80	
General Education Board:		
Mental rating of school children	24,756.47	
Division of educational relations	2,500.00	
Carnegie Corporation of New York:		
Through the Carnegie Institution of Washington	85,000.00	
Direct	15,000.00	
Government:		
National Research Council	40,274.71	
Rice gun	5,802.84	
Reimbursements	12,594.72	
Miscellaneous receipts	1,859.00	
		225,882.24
*Interest on investment	100.00	
*Refund, National Academy of Sciences	35.67	
*Contribution, W. W. Keen	106.22	
Total	241.89	
*These items are taken up in section devoted to National Academy of Sciences, under heading "National Research Council."		
Total		235,833.16

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DISBURSEMENTS.

Divisions:	Jan. 1 to June 30, 1919.	July 1 to Dec. 31, 1919.	
General relations	$27.54		
III. State's relations		$406.22	
IV. Educational relations:			
General maintenance	54.64	613.21	
General Education Board		897.56	
V. Research extension	401.54	375.46	
VI. Research information service	5,813.19	235.45	
VII. Physical sciences:			
Traveling expenses, etc		5,016.80	
General maintenance	872.64	264.72	
VIII. Engineering	15,485.39	251.42	
Office expenses		93.20	
Salaries, Rice gun experiments	336.50		
IX. Chemistry	2,794.50	387.93	
X. Geology and geography	936.80	86.16	
XI. Medical sciences:			
Rockefeller Foundation	11,943.78		
General maintenance		839.18	
XII. Biology and agriculture	4,313.68	604.39	
XIII. Anthropology and psychology		654.04	
Trustees for the publication of Physical and Chemical Constants		272.50	
Total	42,980.20	10,998.24	$53,978.44
General Education Board, mental rating of school children			20,865.87
National research fellowships			12,222.86
Executive board	11,363.13	1,760.31	
Contingent	58.15		
Total	11,421.28	1,760.31	13,181.59
General and office expenses	12,347.23	7,422.89	
Salaries	26,093.71	58,572.75	
Total	38,440.94	65,995.64	104,436.58
Cash on hand Dec. 31, 1919:			
Carnegie Corporation		6,369.81	
Rockefeller Foundation—			
Medical sciences		7,825.82	
Physical sciences		4,000.00	
Research fellowships		7,457.89	
General Education Board—			
Division of educational relations		1,602.44	
Mental rating of school children (This item is included in the balance of $16,922.65 on the books of National Academy, see p. 140)		3,891.86	31,147.82

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On deposit with National Academy of Sciences Dec. 31, 1919:	
Invested	$1,865.00
Uninvested	1,301.73
Total	3,166.73
*These items are taken up in section devoted to National Academy under heading "National Research Council," see p. 144.	
Total	$285,833.16

F. L. RANSOME, *Treasurer.*

JANUARY 15, 1920.

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REPORT OF THE AUDITING COMMITTEE.

WASHINGTON, D. C., *January 15, 1920.*

We have employed the Capital Audit Co. to scrutinize and report on the treasurer's books. We accepted the certifications, dated January 14, 1920, of the American Security & Trust Co. regarding notes on deposit for collection owned by the Academy, and bonds owned by the Academy pledged as collateral security for an advance of funds on account of the building site; we have examined the securities and papers contained in the box of National Academy of Sciences at the vault of the American Security & Trust Co. We find them to correspond to the list checked by the auditing committee on January 15, 1919, except as modified by transactions of the year 1919 reported by the Capital Audit Co., and excepting the bonds held as collateral as above. We find that the coupons due in 1919 have been cut and accounted for, and those due January 1, 1920, are detached and are accounted for by appropriate entries in the pass books. We find that interest on loans has been accounted for, including the interest on the Upshur note mentioned in the report of January 15, 1919, as retained by litigation. Correspondence between vouchers, pass books, and accounts of the treasurer is certified by the Capital Audit Co. We find the balance reported by the treasurer as of December 31, 1919, to accord with the statement of the American Security & Trust Co. and with the check book, except for certain outstanding checks to the amount of $712.50 listed by the treasurer and verified by the Capital Audit Co.

In addition to the financial statement of the treasurer covering the accounts of the National Academy proper there is also a statement of the accounts of the National Research Council, whose funds are deposited in various separate accounts to the credit of the Academy. These accounts have been included in the report of the Capital Audit Co. We find that the treasurer's balance as of December 31, 1919, agrees with the statements of the American Security & Trust Co. and of Riggs National Bank for these accounts.

L. O. HOWARD.
C. E. MENDENHALL.
DAVID WHITE.

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APPENDIXES.

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APPENDIX A.

CONSTITUTION OF THE NATIONAL ACADEMY.

As amended and adopted April 17, 1872, and further amended April 20, 1875; April 21, 1881; April 19, 1882; April 18, 1883; April 19, 1888; April 18, 1895; April 20, 1899; April 17, 1902; April 18, 1906; November 20, 1906; April 17, 1907; November 20, 1907; April 20, 1911; April 16, 1912; April 21, 1915.

PREAMBLE.

Empowered by the act of incorporation enacted by Congress, and approved by the President of the United States on the 3d day of March, A. D. 1863, and in conformity with amendments to said act approved July 14, 1870, June 20, 1884, and May 27, 1914, the National Academy of Sciences adopts the following amended constitution and rules:

ARTICLE I.—OF MEMBERS.

SECTION 1. The academy shall consist of members, honorary members, and foreign associates. Members must be citizens of the United States.

SEC. 2. Members who, from age or inability to attend the meetings of the academy, wish to resign the duties of active membership, may, at their own request, be transferred to the roll of honorary members by a vote of the academy.

SEC. 3. The academy may elect 50 foreign associates.

SEC. 4. Honorary members and foreign associates shall have the privilege of attending the meetings and of reading and communicating papers to the academy, but shall take no part in its business, shall not be subject to its assessments, and shall be entitled to a copy of the publications of the academy.

ARTICLE II.—OF THE OFFICERS.

SECTION 1. The officers of the academy shall be a president, a vice president, a foreign secretary, a home secretary, and a treasurer, all of whom shall be elected for a term of four years, by a majority of votes present, at the first stated meeting after the expiration of the current terms, provided that existing officers retain their places until their successors are elected. In case of a vacancy, the election for

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four years shall be held in the same manner at the meeting when such vacancy occurs, or at the next stated meeting thereafter, as the academy may direct. A vacancy in the office of treasurer or home secretary may, however, be filled by appointment of the president of the academy until the next stated meeting of the academy.

SEC. 2. The officers of the academy, together with six members to be elected by the academy, shall constitute a council for the transaction of such business as may be assigned to them by the constitution or the academy.

SEC. 3. The president of the academy, or, in case of his absence or inability to act, the vice president, shall preside at the meetings of the academy and of the council; shall name all committees except such as are otherwise especially provided for; shall refer investigations required by the Government of the United States to members especially conversant with the subjects and report thereon to the academy at its meeting next ensuing; and, with the council, shall direct the general business of the academy.

It shall be competent for the president, in special cases, to call in the aid, upon committees, of experts or men of special attainments not members of the academy.

The president shall be, ex officio, a member of all committees empowered to consider questions referred to the academy by the Government of the United States.

SEC. 4. The foreign and home secretaries shall conduct the correspondence proper to their respective departments, advising with the president and council in cases of doubt, and reporting their action to the academy at one of the stated meetings in each year.

It shall be the duty of the home secretary to give notice to the members of the place and time of all meetings, of all nominations for membership, and of all proposed amendments to the constitution.

It shall be the duty of the home secretary to keep the minutes of each business and scientific session, and after approval to enter these upon the permanent records of the academy.

SEC. 5. The treasurer shall attend to all receipts and disbursements of the academy, giving such bond and furnishing such vouchers as the council may require. He shall collect all dues, assessments, and subscriptions, and keep a set of books showing a full account of receipts and disbursements and the condition of all funds of the academy. He shall be the custodian of the corporate seal of the academy.

ARTICLE III.—OF THE MEETINGS.

SECTION 1. That the academy shall hold one stated meeting, called the annual meeting, in April of each year in the city of Washington, and another stated meeting, called the autumn meeting, at a place

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to be determined by the council. The council shall also have power to fix the date of each meeting.

Special business meetings of the academy may be called, by order of eight members of the council, at such place and time as may be designated in the call.

Special scientific meetings of the academy may be held at times and places to be designated by a majority of the council.

SEC. 2. The names of the members present at each session of a meeting shall be recorded in the minutes, and the members present at any session shall constitute a quorum for the transaction of business.

SEC. 3. Scientific sessions of the academy, unless otherwise ordered by a majority of the members present, shall be open to the public; sessions for the transaction of business shall be closed.

SEC. 4. Stated meetings of the council shall be held during the stated or special meetings of the academy and four members shall constitute a quorum for the transaction of business. Special meetings of the council may be convened at the call of the president and two members of the council, or of four members of the council.

SEC. 5. No member whose dues are in arrears shall vote at any business meeting of the academy.

ARTICLE IV.—OF ELECTIONS AND RESIGNATIONS.

SECTION 1. All elections of officers and members shall be by ballot, and each election shall be held separately.

SEC. 2. The time for holding an election of officers shall be fixed by the academy at least one day before the election is held.

SEC. 3. The election of the six members of the council shall be as follows:

At the annual meeting in April, 1907, six members of the council to be elected, of whom two shall serve for three years, two for two years, and two for one year, their respective terms to be determined by lot. Each year thereafter the terms of two members shall expire, and their successors, to serve for three years, shall be elected at the annual meeting in each year.

SEC. 4. The academy shall be divided by the council into sections representing the principal branches of scientific research. Each section shall elect its own chairman, who shall serve for three years. The chairman shall be responsible to the academy for the work of his section.

Nominations to membership in the academy shall be made in writing and approved by a majority of the members of the section on the branch of research in which the person nominated is eminent, or by a majority of the council in case there is no section on the subject.

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The nomination shall be sent to the home secretary by the chairman of the section before January 1 of the year in which the election is to be held, and each nomination shall be accompanied by a list of the principal contributions of the nominee to science. This list shall be printed by the home secretary for distribution among the members of the academy.

SEC. 5. Election of members shall be held at the annual meeting in Washington in the following manner: There shall be two ballots—a preference ballot, which may be prepared either before or at the annual meeting, and must be transmitted to the home secretary, and a final ballot, to be taken at the meeting.

Preference ballot.—Each member may inscribe on a ballot not more than 15 names of nominees selected from the submitted list. A list of the nominees shall then be prepared, on which the names shall be entered in the order of the number of votes received by each. In case two or more nominees have the same number of votes on this preference list, the order in which they shall be placed on the list shall be determined by a majority vote of members present.

Final ballot.—A vote shall first be taken on the nominee who appears first on the preference list, and he shall be declared elected if he receive two-thirds of the votes cast and not less than 25 votes in all. A vote shall then be taken in similar manner on the nominee standing second on the preference list, and so on until all the nominees on the preference list shall have been acted on, or until 15 nominees shall have been elected, or until the total membership of the academy shall have reached 250.

Not more than 15 members shall be elected at one annual meeting.

Before and during elections a discussion of the merits of nominees will be in order.

SEC. 6. Every member-elect shall accept his membership, personally or in writing, before the close of the next stated meeting after the date of his election. Otherwise, on proof that the secretary has formally notified him of his election, his name shall not be entered on the roll of members.

SEC. 7. Foreign associates may be nominated by the council and may be elected at the annual meeting by a two-thirds vote of the members present.

SEC. 8. A diploma, with the corporate seal of the academy and the signatures of the officers, shall be sent by the appropriate secretary to each member on his acceptance of membership, and to foreign associates on their election.

SEC. 9. Resignations shall be addressed to the president and acted on by the academy.

SEC. 10. Whenever a member has not paid his dues for four successive years, the treasurer shall report the fact to the council, which

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may report the case to the academy with the recommendation that the person thus in arrears be declared to have forfeited his membership. If this recommendation be approved by two-thirds of the members present, the said person shall no longer be a member of the academy and his name shall be dropped from the roll.

ARTICLE V.—SCIENTIFIC COMMUNICATIONS, PUBLICATIONS, AND REPORTS.

SECTION 1. Communications on scientific subjects shall be read at scientific sessions of the academy, and papers by any member may be read by the author or by any other member, notice of the same having been previously given to the secretary.

SEC. 2. Any member of the academy may read a paper from a person who is not a member, and shall not be considered responsible for the facts or opinions expressed by the author, but shall be held responsible for the propriety of the paper.

Persons who are not members may read papers on invitation of the council or of the committee of arrangements.

SEC. 3. The academy may provide for the publication, under the direction of the council, of proceedings, scientific memoirs, biographical memoirs, and reports.

The proceedings shall include the transactions of the academy, brief original announcements of the results of scientific investigations made by members of the academy or others, together with short original articles giving a comprehensive survey of the more important scientific researches currently made by American investigators, and other matters of general scientific interest.

The scientific memoirs shall provide opportunity for the publication of longer and more detailed scientific investigations.

The biographical memoirs shall contain an appropriate record of the life and work of deceased members of the academy.

An annual report shall be presented to Congress by the president and shall contain the annual reports of the treasurer and the auditing committee, a suitable summary of the reports of the committees in charge of trust funds, and a record of the activities of the academy for the calendar year immediately preceding, and other appropriate matter. This report shall be presented to Congress by the president after authorization by the council. It shall also be presented to the academy at the annual meeting next following.

The treasurer shall prepare a full report of the financial affairs of the academy at the end of the fiscal year. This report shall be submitted to the council for approval and afterwards presented to the academy at the annual meeting.

SEC. 4. Propositions for investigations or reports by the academy shall be submitted to the council for approval, except those requested

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by the Government of the United States, which shall be acted on by the president, who will in such cases report their results to the Government as soon as obtained and to the academy at its next following stated meeting.

SEC. 5. The advice of the academy shall be at all times at the disposition of the Government upon any matter of science or art within its scope.

ARTICLE VI.—OF THE PROPERTY OF THE ACADEMY.

SECTION 1. All investments and reinvestments of either principal or accumulations of income of the trust and other funds of the academy shall be made by the treasurer, with the approval of the finance committee, in the corporate name of the academy, in the manner and in the securities designated or specified in the instruments creating the several funds, or, in the absence of such designation or specification, in bonds of the United States or of the several States, or in bonds or notes secured by first mortgages on real estate, in investments legal for savings banks under the laws of Massachusetts or New York, or in other bonds recommended to the treasurer by the fiscal advisers of the academy.

The treasurer may invest the capital of all trust funds of the academy which are not required by the instruments creating such funds to be kept separate and distinct, in a consolidated fund, and shall apportion the income received from such consolidated fund among the various funds composing the same in the proportion that each of said funds shall bear to the total amount of funds so invested; provided, however, that the treasurer shall at all times keep accurate accounts showing the amount of each trust fund, the proportion of the income from the consolidated fund to which it is entitled, and the expenses and disbursements properly chargeable to such fund.

SEC. 2. The council shall at its annual meeting in each year designate one bank or trust company in Washington, D. C., and one in New York City to act, when requested by the treasurer, as the fiscal advisers of the academy.

SEC. 3. The treasurer shall have authority, with the approval of the finance committee, to sell, transfer, convey, and deliver in the corporate name and for the benefit of the academy any stocks, bonds, or other securities standing in the corporate name.

SEC. 4. No contract shall be binding upon the academy which has not been first approved by the council.

SEC. 5. The assessments required for the support of the academy shall be fixed by the academy on the recommendation of the council and shall be payable within the calendar year for which they are assessed.

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ARTICLE VII.—OF TRUST FUNDS AND THEIR ADMINISTRATION.

SECTION 1. Devises, bequests, donations, or gifts having for their object the promotion of science or the welfare of the academy may be accepted by the council for the academy. Before the acceptance of any such trust the council shall consider the object of the trust and all conditions or specifications attaching thereto. The council shall make a report of its action to the academy.

SEC. 2. Medals and prizes may be established in accordance with the provisions of trusts or by action of the academy.

SEC. 3. Unless otherwise provided by the deed of gift, the income of each trust fund shall be applied to the objects of that trust by the action of the academy on the recommendation of a standing committee on that fund.

ARTICLE VIII.—OF ADDITIONS AND AMENDMENTS.

Additions and amendments to the constitution shall be made only at a stated meeting of the academy. Notice of a proposition for such a change must be submitted to the council, which may amend the proposition, and shall report thereon to the academy. Its report shall be considered by the academy in committee of the whole for amendment.

The proposition as amended, if adopted in committee of the whole, shall be voted on at the next stated meeting, and if it receives two-thirds of the votes cast it shall be declared adopted.

Absent members may send their votes on pending changes in the constitution to the home secretary in writing, and such votes shall be counted as if the members were present.

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APPENDIX B.

RULES.

(In accordance with a resolution of the academy, taken at its meeting on April 21, 1915, the rules are arranged in groups and each group is numbered to correspond with the article of the constitution to which it relates.)

I.

1. The holders of the medal for eminence in the application of science to the public welfare shall be notified, like members, of the meetings of the academy, and invited to participate in its scientific sessions.

II.

1. The proper secretary shall acknowledge all donations made to the academy, and shall at once report them to the council for its consideration.

2. The home secretary shall be the custodian of all books, apparatus, archives, and collections not explicitly assigned to other care.

3. The home secretary shall keep a record of all grants of money or awards of prizes or medals made from trust funds of the academy. The record for each grant of money shall include the following items:

1. Name of fund.
2. Date and number of the grant.
3. Name and address of recipient.
4. Amount of grant and date or dates of payment.
5. Purpose of grant.
6. Record of report of progress.
7. Resulting publications.

4. The treasurer shall keep the home secretary informed of all warrants received from directors of trust funds not controlled by the academy and of the date or dates of payment of all warrants.

5. The treasurer is authorized to defray, when approved by the president, all the proper expenses of committees appointed to make scientific investigations at the request of departments of the Government, and in each case to look to the department requesting the investigation for reimbursement to the academy.

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6. The treasurer is authorized to act as the treasurer ex officio of the National Research Council.

7. The treasurer shall have the assistance of a salaried and bonded officer, the bursar, who shall be chosen by the finance committee and be directly responsible to the treasurer.

III.

1. The annual meeting of the academy shall begin on the fourth Monday of April. At the business sessions of the academy the order of procedure shall be as follows:

(1) Chair taken by the president, or, in his absence, by the vice president.
(2) Roll of members called by home secretary (first session of the meeting only).
(3) Minutes of the preceding session read and approved.
(4) Stated business.
(5) Reports of president, secretaries, treasurer, and committees.
(6) Business from council.
(7) Other business.

2. The rules of order of the academy shall be those of the Senate of the United States, unless otherwise provided by the constitution or rules of the academy.

3. In the absence of any officer a member shall be chosen to perform his duties temporarily, by a plurality of viva voce votes, upon open nomination.

4. At each meeting the president shall announce the death of any members since the preceding meeting. As soon as practicable thereafter he shall designate a member to write—or to secure from some other source approved by the president—a biographical notice of each deceased member.

5. A local committee of five members, appointed for each meeting, and the home secretary shall together constitute the committee of arrangements, of which the home secretary shall be chairman.

It shall be the duty of the committee of arrangements to prepare the scientific program for the annual meeting, and for this purpose it shall be empowered to solicit papers from members or others. It shall also be empowered to ascertain the length of time required for reading papers to be presented at the scientific sessions of the academy, and, when it appears advisable, to limit the time to be occupied in their presentation or discussion.

The committee of arrangements shall meet not less than two months previous to each meeting. It shall prepare the detailed program of each day, and in general shall have charge of all business and scientific arrangements for the meeting for which it is appointed.

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IV.

1. The term of service of each chairman of a section shall be three years, to date from the closing session of the April meeting next following his election. Chairmen of sections shall be chosen by mail ballot, the member receiving the highest number of votes cast to be deemed elected. It shall be the duty of each retiring chairman to conduct the election of his successor and to report the result of the election to the home secretary before the April meeting at which his term of service expires. Should any section fail to elect a chairman before November 1, the president is empowered to appoint a temporary chairman to serve until the April meeting next following. No chairman shall be eligible for reelection for two consecutive terms.

2. The chairman of each section of the academy shall submit to the members of his section, not later than November 1 of each year, a ballot containing the names of all those persons who received not less than two votes in the nominating ballot of the preceding year and of any other persons who were newly proposed for consideration at that time. Each member of the section shall be expected to return this ballot to the chairman within two weeks with his signature and with crosses placed against the names of those persons whom he is prepared to indorse for nomination. Each member may also write upon the ballot in a place provided for the purpose any new names which he desires to have included in the ballot to be submitted to the section in the following year. The vote resulting from this ballot shall be regarded as informal.

The chairman shall then submit to the members of his section a new ballot showing the results of the informal vote; and each member shall be expected to return this ballot to the chairman with his signature and with crosses placed against the names of those persons whom he will indorse for nomination. In order to secure an adequate number of nominations, the chairman, when necessary, shall obtain by personal solicitation a fuller vote of his section or shall submit to the section a supplementary formal ballot.

The chairman shall then certify to the home secretary, prior to January 1, the names of those persons who have been voted for on the formal ballots by a majority of the members of the section, and shall furnish him a list of the publications of these nominees, as required by the constitution.

3. Nominations for membership shall give the full name, residence, and the official positions successively held by the candidate, in addition to the list of his contributions to science required by the constitution.

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4. Preference ballots for election of members shall be sealed in a blank envelope, which shall be inclosed in another bearing the name of the sender, and which shall be addressed to the home secretary. Such envelopes shall be opened only by the tellers. If in any case the tellers are unable to determine who cast a ballot, or if the latter contains more names than are to be voted for, the ballot shall be rejected, but minor defects in a ballot shall be disregarded when the intent of the voter is obvious.

5. All discussions of the claims and qualifications of nominees at meetings of the academy shall be held strictly confidential, and remarks and criticisms then made may be communicated to no person who was not a member of the academy at the time of the discussion.

V.

1. The publication of the proceedings shall be under the general charge of the council, which shall have final jurisdiction upon all questions of policy relating thereto. The preparation of the proceedings for publication shall be intrusted to an editorial board. This board shall consist of a chairman and a managing editor, both of whom shall be appointed by the council for definite terms of service; of the home secretary and foreign secretary *ex officiis*, and of a body of associate editors representing the various branches of science which are to be included in the scope of the proceedings. The managing editor, who may be a nonmember of the academy, shall receive a salary, which shall be fixed by the council. It shall be the duty of the managing editor to prepare the proceedings in detail for publication; but the chairman of the editorial board shall decide, in consultation with the managing editor, in regard to the acceptance, rejection, or substantial modification of papers offered for publication. The associate editors shall be appointed by the council, upon recommendation of the chairman of the editorial board, for a period of three years, one-third of them retiring annually. The home secretary and the foreign secretary shall be responsible for the distribution of the proceedings in their respective fields.

2. Memoirs may be presented at any time to the home secretary, who shall report the date of their reception at the next session; but no memoir shall be published unless it has been read or presented by title before the academy.

Before publication all biographical and scientific memoirs must be referred to the committee on publication, who may, if they deem best, refer any memoir to a special committee appointed by the president to determine whether the same should be published by the academy.

3. Memoirs shall date, in the records of the academy, from the date of their presentation to the Academy, and the order of their

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presentation shall be so arranged by the secretary that, so far as may be convenient, those upon kindred topics shall follow one another.

4. The annual report of the treasurer shall contain:

(1) A concise statement of the source, object, and amount of all trust funds of the Academy.
(2) A condensed statement of receipts and expenditures.
(3) A statement of assets and liabilities.
(4) Accounts with individual funds.
(5) Such other matter as he considers appropriate.

5. The accounts of the treasurer shall, between January 1 and January 15 of each year, be audited by a committee of three members to be appointed by the president at the autumn meeting of the Academy. It shall be the duty of the auditing committee to verify the record of receipts and disbursements maintained by the treasurer and the agreement of book and bank balances; to examine all securities in the custody of the treasurer and to compare the stated income of such securities with the receipts of record; to examine all vouchers covering disbursements for account of the Academy and the authority therefor and to compare them with the treasurer's record of expenditures; to examine and verify the account of the Academy with each trust fund. The auditing committee may employ an expert accountant to assist the committee in the examination of the books of the treasurer. The annual report of the treasurer shall be published with that of the president to Congress. The reports of the treasurer and auditing committee shall be presented to the Academy at the annual meeting.

VI.

1. All apparatus and other materials of permanent value purchased with money from any grant from a trust fund shall be the property of the Academy unless specific exception is made in the grant or by subsequent action of the council or the directors of the trust fund concerned. Receipts for all such property shall be signed by the grantee and shall be forwarded to the home secretary. All apparatus and unused material of value acquired in this way shall be delivered to the home secretary on completion of the investigation for which the grant was made, or at any time on demand of the council, and the home secretary shall give an appropriate release therefor.

2. The books, apparatus, archives, and other collections of the Academy shall be deposited in some safe place in the city of Washington. A list of the articles so deposited shall be kept by the home secretary, who is authorized to employ a clerk to take charge of them.

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3. A stamp corresponding to the corporate seal of the Academy shall be kept by the secretaries, who shall be responsible for the due markings of all books and other objects to which it is applicable.

Labels or other proper marks of similar device shall be placed upon objects not admitting of the stamp.

4. The fiscal year of the Academy shall end on December 31 of each year.

5. The standing committee on finance shall consist of the president of the Academy ex officio, the treasurer ex officio as chairman, and two members to be appointed annually by the president.

That a budget committee on the expenses of the National Academy and the National Research Council, to consist of the president of the Academy, the chairman of the National Research Council, and the treasurer of the National Academy of Sciences and the National Research Council, be appointed and the president of the Academy act as chairman.

VII.

1. Standing committees of the Academy on trust funds the income of which is applied to the promotion of research shall consist of three or five members. In order to secure rotation in office in such committees, when not in conflict with the provisions of the deeds of gift, the term of service on a committee of three members shall be three years; on a committee of five members the term shall be five years.

2. The annual reports of the committees on research funds shall, so far as the Academy has authority to determine their form, give a current number to each award, stating the name, position, and address of the recipient; the subject of research for which the award is made, and the sum awarded; and in later annual reports the status of the work accomplished under each award previously made shall be announced, until the research is completed, when announcement of its completion and, if published, the title and place of publication shall be stated, and the record of the award shall be reported as closed.

VIII.

1. Any rule of the Academy may be amended, suspended, or repealed on the written motion of any two members, signed by them, and presented at a stated meeting of the Academy, provided the same shall be approved by a majority of the members present.

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APPENDIX C.

ORGANIZATION OF THE ACADEMY, 1919–20.

	Expiration of term.
WALCOTT, CHARLES D., *President*	April, 1923
MICHELSON, A. A., *Vice President*	April, 1923
HALE, GEORGE E., *Foreign Secretary*	April, 1922
ABBOT, C. G., *Home Secretary*	April, 1923
RANSOME, F. L., *Treasurer*	April, 1923

ADDITIONAL MEMBERS OF COUNCIL.

1917–1920.

CONKLIN, E. G. — NOYES, A. A.

1918–1921.

PEARL, RAYMOND — HOWELL, W. H.

1919–1922.

CARTY, J. J. — DONALDSON, H. H.

SECTIONS.

1. MATHEMATICS.

BIRKHOFF, G. D.
BLISS, G. A.
BOLZA, OSKAR
DICKSON, L. E.
KASNER, EDWARD
MOORE, E. H.
OSGOOD, W. F.
STORY, W. E.
VAN VLECK, E. B.
VEBLEN, OSWALD
WHITE, H. S. (*Chairman, 1922*)
WILCZYNSKI, E. J.

2. ASTRONOMY.

ABBOT, C. G.
ADAMS, W. S.
AITKEN, R. G.
BARNARD, E. E.
CAMPBELL, W. W. (*Chairman, 1917–1920*)
COMSTOCK, G. C.
CURTIS, H. D.
ELKIN, W. L.
FROST, E. B.
HALE, G. E.
LEUSCHNER, A. O.
MOULTON, F. R.
RUSSELL, H. N.
SCHLESINGER, FRANK
SEARES, F. H.

3. PHYSICS.

AMES, J. S.
BARUS, CARL
BELL, A. G.
BRIDGMAN, P. W.
BUMSTEAD, H. A.
CREW, HENRY
HALL, E. H.
HASTINGS, C. S.
HAYFORD, J. F.
LYMAN, THEODORE
MENDELHALL, C. E.
MENDENHALL, T. C.
MERRITT, ERNEST
MICHELSON, A. A.
MILLIKAN, R. A.
NICHOLS, E. F. (*Chairman, 1917–1920*)
NICHOLS, E. L.
PUPIN, M. I.
ROSA, E. B.
STRATTON, S. W.
THOMSON, ELIHU
TROWBRIDGE, AUGUSTUS
TROWBRIDGE, JOHN
WEBSTER, A. G.
WILSON, EDWIN B.
WOOD, R. W.
WOODWARD, R. S.

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4. ENGINEERING.

ABBOT, H. L.
CARTY, J. J.
DUNN, GANO
(*Acting Chairman*)
DURAND, W. F.
FREEMAN, J. R.
HOWE, H. M.
JEWETT, F. B.
SQUIER, G. O.
TAYLOR, D. W.

5. CHEMISTRY.

BAXTER, G. P.
BOGERT, M. T.
BOLTWOOD, B. B.
CHANDLER, C. F.
CLARKE, F. W.
FRANKLIN, E. C.
GOMBERG, MOSES
GOOCH, F. A.
HILLEBRAND, W. F.
JACKSON, C. L.
JOHNSON, TREAT B.
LANGMUIR, IRVING
LEWIS, G. N.
MICHAEL, ARTHUR
MORLEY, E. W.
MORSE, H. N.
NOYES, A. A.
NOYES, W. A.
(*Chairman, 1919–1922*)
OSBORNE, T. B.
REMSEN, IRA
RICHARDS, T. W.
SMITH, ALEXANDER
SMITH, EDGAR F.
STIEGLITZ, JULIUS
WELLS, H. L.
WHITNEY, W. R.

6. GEOLOGY AND PALEONTOLOGY.

BRANNER, J. C.
CHAMBERLIN, T. C.
CLARKE, J. M.
(*Chairman, 1918–1921*)
CROSS, WHITMAN
DALL, W. H.
DANA, E. S.
DAVIS, W. M.
DAY, A. L.
IDDINGS, J. P.
KEMP, J. F.
LINDGREN, WALDEMAR
MERRIAM, J. C.
OSBORN, H. F.
PUMPELLY, RAPHAEL
RANSOME, F. L.
REID, H. F.
SCHUCHERT, CHARLES
SCOTT, W. B.
ULRICH, E. O.
WALCOTT, C. D.
WHITE, DAVID

7. BOTANY.

BAILEY, L. H.
BRITTON, N. L.
CAMPBELL, D. H.
COULTER, J. M.
GOODALE, G. L.
HARPER, R. A.
OSTERHOUT, W. J. V.
SARGENT, C. S.
SETCHELL, W. A.
SMITH, ERWIN F.
(*Chairman, 1918–1921*)
THAXTER, ROLAND
TRELEASE, WILLIAM

8. ZOOLOGY AND ANIMAL MORPHOLOGY.

ALLEN, J. A.
CALKINS, G. N.
CASTLE, W. E.
CONKLIN, E. G.
DAVENPORT, C. B.
DONALDSON, H. H.
FORBES, S. A.
HARRISON, R. G.
HERRICK, C. J.
HOWARD, L. O.
JENNINGS, H. S.
LILLIE, F. R.
MARK, E. L.
MAYOR, A. G.
MERRIAM, C. H.
MORGAN, T. H.
(*Chairman, 1919–1922*)
MORSE, E. S.
PARKER, G. H.
PEARL, RAYMOND
RIDGWAY, ROBERT
VERRILL, A. E.
WHEELER, W. M.
WILSON, EDMUND B.

9. PHYSIOLOGY AND PATHOLOGY.

ABEL, J. J.
BENEDICT, F. G.
CANNON, W. B.
CHITTENDEN, R. H.
COUNCILMAN, W. T.
CUSHING, HARVEY
FLEXNER, SIMON
FOLIN, OTTO
HALSTED, W. S.
HEKTOEN, LUDVIG
HENDERSON, L. J.
HOWELL, W. H.
HUNT, REID
JONES, WALTER
LEVENE, P. A. T.
LOEB, JACQUES
LUSK, GRAHAM
MELTZER, S. J.
MENDEL, L. B.
(*Chairman, 1919–1922*)
PRUDDEN, T. M.
SMITH, THEOBALD
VAUGHAN, V. C.
WELCH, W. H.
WOOD, H. C.

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10. ANTHROPOLOGY AND PSYCHOLOGY.

BOAS, FRANZ — FEWKES, J. W. (*Acting Chairman*) — HOLMES, W. H.
CATTELL, J. McK. — THORNDIKE, E. L.
DEWEY, JOHN — HALL, G. S.

STANDING COMMITTEES.

ON WEIGHTS, MEASURES, AND COINAGE.

MENDENHALL, T. C. (*Chairman*) — MICHELSON, A. A. — MORLEY, E. W.
WEBSTER, A. G. — WOODWARD, R. S.

ON SOLAR RESEARCH.

HALE, G. E. (*Chairman*). — CAMPBELL, W. W. — MICHELSON, A. A.
NICHOLS, E. L.

ON PUBLICATION.

The PRESIDENT. — The HOME SECRETARY. — ROSA, E. B.

EDITORIAL BOARD OF THE PROCEEDINGS.

PEARL, RAYMOND (*Chairman*). — ABBOT, C. G. (*Home Secretary*).
WILSON, EDWIN B. (*Managing Editor*). — HALE, G. E. (*Foreign Secretary*).

CLARKE, J. M., 1921.	HENDERSON, L. J., 1922.	MOORE, E. H., 1920.
DAY, A. L., 1922.	JENNINGS, H. S., 1921.	NOYES, W. A., 1921.
DUNN, GANO, 1922.	LOEB, JACQUES, 1920.	OSTERHOUT, W. J. V., 1922.
FROST, E. B., 1920.	MERRIAM, J. C., 1922.	THORNDIKE, E. L., 1920.
HEKTOEN, LUDVIG, 1921.	MILLIKAN, R. A., 1921.	WHEELER, W. M., 1920.

ON COLLECTION OF HISTORICAL PORTRAITS, MANUSCRIPTS, INSTRUMENTS, ETC.

WALCOTT, C. D. (*Chairman*). — CLARKE, F. W. — HALE, G. E.
MELTZER, S. J. — PUPIN, M. I.

FINANCE COMMITTEE.

RANSOME, F. L. (*Chairman*). — CROSS, WHITMAN. — DUNN, GANO.
WALCOTT, C. D.

TRUST FUNDS.

THE BACHE FUND.

[$59,000.]

Researches in physical and natural science.

FROST, E. B. (*Chairman*). — HARRISON, R. G. — WEBSTER, A. G.

THE WATSON FUND.

[$25,000.]

Watson medal and the promotion of astronomical research.

LEUSCHNER, A. O. (*Chairman*). — COMSTOCK, G. C. — ELKIN, W. L.

THE HENRY DRAPER FUND.

[$10,000.]

Draper medal and investigations in astronomical physics.

CAMPBELL, W. W. (*Chairman*), 1924. — ABBOT, C. G., 1921. — AMES, J. S., 1920.
HALE, G. E., 1923. — MICHELSON, A. A., 1922.

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THE J. LAWRENCE SMITH FUND.

[$10,000.]

J. Lawrence Smith medal and investigations of meteoric bodies.

MORLEY, E. W. (*Chairman*), 1924. DANA, E. S., 1923. CROSS, WHITMAN, 1922.
LEUSCHNER, A. O., 1920. WOOD, R. W., 1921.

THE BARNARD MEDAL.[1]

Meritorious service to science.

NOYES, A. A. (*Chairman*). CAMPBELL, W. W. NICHOLS, E. F.
MORGAN, T H. RICHARDS, T. W.

THE BENJAMIN APTHORP GOULD FUND.

[$20,000.]

Researches in astronomy.

MOULTON, F. R. (*Chairman*). BARNARD, E. E. WOODWARD, R. S.

THE WOLCOTT GIBBS FUND.

[$5,545.50.]

Chemical research.

JACKSON, C. L. (*Chairman*). RICHARDS, T. W. SMITH, EDGAR F.

THE COMSTOCK FUND.

[$12,406.02.]

Researches in electricity, magnetism, and radiant energy.

NICHOLS, E. L. (*Chairman*), 1923. MILLIKAN, R. A., 1921. WHITNEY, W. R., 1924.
THOMPSON, ELIHU, 1920. WEBSTER, A. G., 1922.

THE MARSH FUND.

[$19,500.]

Original research in the natural sciences.

MERRIAM, J. C. (*Chairman*), 1922. DANA, E. S., 1920.
SCHUCHERT, CHARLES, 1921.

THE AGASSIZ FUND.

[$50,000.]

General uses of the Academy.

THE MURRAY FUND.

[$6,000.]

Agassiz medal and contributions to oceanography.

DALL, W. H. (*Chairman*), 1921. DAVIS, W. M., 1922. PARKER, G. H., 1920.

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[1] Every five years the committee recommends the person whom they consider most deserving of the medal, and upon the approval of the academy the name of the nominee is forwarded to the trustees of Columbia University, who administer the Barnard Medal Fund.

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THE MARCELLUS HARTLEY FUND.

[$1,200.]

Medal for eminence in the application of science to the public welfare.

NOYES, A. A. (*Chairman*), 1922. STRATTON, S. W., 1922.
OSBORN, H. F., 1921. PUPIN, M. I., 1921. SMITH, THEOBALD, 1920.
WEBSTER, A. G., 1920.

THE MARY CLARK THOMPSON FUND.

[$10,000.]

Medal for most important services to geology and paleontology.

CLARKE, J. M. (*Chairman*), 1922. DUNN, GANO, 1920. OSBORN, H. F., 1921.

THE JOSEPH HENRY FUND.

To assist meritorious investigators, especially in the direction of original research.

The sum of $40,000 was contributed by Fairman Rogers, Joseph Patterson, George W. Childs, and others, as an expression of their respect and esteem for Prof. Joseph Henry. This amount was deposited with the Pennsylvania Co. for the Insurance of Lives and Granting Annuities in Trust, with authorization to collect the income thereon and to pay over the same to Prof. Joseph Henry during his natural life, and after his death to his wife and daughters, and after the death of the last survivor to "deliver the said fund and the securities in which it shall then be invested to the National Academy of Sciences, to be thenceforward forever held in trust under the name and title of the 'Joseph Henry fund.'"

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MEMBERS OF THE NATIONAL ACADEMY OF SCIENCES.

DECEMBER 31, 1919.

		Date of election.
ABBOT, CHARLES GREELEY	*Smithsonian Institution, Washington, D. C.*	1915
ABBOT, HENRY L., U. S. A.	*23 Berkeley St., Cambridge 38, Mass.*	1872
ABEL, JOHN JACOB	*Johns Hopkins University, Baltimore, Md.*	1912
ADAMS, WALTER SYDNEY	*Solar Observatory Office, Pasadena, Calif.*	1917
AITKEN, ROBERT GRANT	*Lick Observatory, Mount Hamilton, Calif.*	1918
ALLEN, J. ASAPH	*American Museum of Natural History, N. Y. City.*	1876
AMES, JOSEPH S.	*Johns Hopkins University, Baltimore, Md.*	1909
BAILEY, LIBERTY HYDE	*Ithaca, N. Y.*	1917
BARNARD, E. E.	*Yerkes Observatory, Williams Bay, Wis.*	1911
BARUS, CARL	*Brown University, Providence, R. I.*	1892
BAXTER, GREGORY PAUL	*T. J. Coolidge, jr., Mem. Lab., Cambridge, Mass.*	1916
BELL, A. GRAHAM	*1331 Connecticut Ave., Washington, D. C.*	1883
BENEDICT, FRANCIS GANO	*Nutrition Laboratory, Boston 17, Mass.*	1914
BIRKHOFF, GEORGE DAVID	*Harvard University, Cambridge, Mass.*	1918
BLISS, GILBERT AMES	*University of Chicago, Chicago, Ill.*	1916
BOAS, FRANZ	*Columbia University, New York City.*	1900
BOGERT, MARSTON TAYLOR	*Columbia University, New York City.*	1916
BOLTWOOD, B. B.	*Yale University, New Haven, Conn.*	1911
BOLZA, OSKAR	*Reichsgrafenstr. 10, Freiburg, Germany.*	1909
BRANNER, JOHN C.	*Stanford University, California.*	1905
BRIDGMAN, PERCY WILLIAMS	*Jefferson Phys. Lab., Cambridge, Mass.*	1918
BRITTON, NATHANIEL LORD	*New York Botanical Gardens, N. Y. City.*	1914
BUMSTEAD, HENRY ANDREWS	*Yale University, New Haven, Conn.*	1913
CALKINS, GARY NATHAN	*Columbia University, New York City.*	1919
CAMPBELL, D. H.	*Stanford University, California,*	1910
CAMPBELL, WILLIAM W.	*Lick Observatory, Mount Hamilton, Calif.*	1902
CANNON, WALTER BRADFORD	*Harvard University, Cambridge, Mass.*	1914
CARTY, JOHN J.	*Am. Telegraph and Telephone Co., N. Y. City.*	1917
CASTLE, WILLIAM ERNEST	*186 Payson Road, Belmont, Mass.*	1915
CATTELL, JAMES MCK.	*Garrison, N. Y.*	1901
CHAMBERLIN, THOMAS C.	*University of Chicago, Chicago, Ill.*	1903
CHANDLER, CHARLES F.	*Columbia University, New York City.*	1874
CHITTENDEN, RUSSELL H.	*Sheffield Scientific School, New Haven, Conn.*	1890
CLARKE, F. W.	*U. S. Geological Survey, Washington, D. C.*	1909
CLARKE, J. M.	*State Museum, Albany, N. Y.*	1909
COMSTOCK, GEORGE C.	*Washburn Observatory, Madison, Wis.*	1899
CONKLIN, E. G.	*Princeton, N. J.*	1908
COULTER, J. M.	*University of Chicago, Chicago, Ill.*	1909
COUNCILMAN, WILLIAM T.	*Harvard Medical School, Boston, Mass.*	1904
CREW, HENRY	*Northwestern University, Evanston, Ill.*	1909
CROSS, WHITMAN	*2138 Bancroft Place, Washington, D. C.*	1908
CURTIS, HEBER DOUST	*Lick Observatory, Mount Hamilton, Calif.*	1919
CUSHING, HARVEY	*Harvard University, Cambridge, Mass.*	1917

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		Date of election.
DALL, WILLIAM H	*Smithsonian Institution, Washington, D. C.*	1897
DANA, EDWARD S	*Yale University, New Haven, Conn.*	1884
DAVENPORT, CHARLES B	*Cold Spring Harbor, N. Y.*	1912
DAVIS, WILLIAM MORRIS	*31 Hawthorn St., Cambridge 38, Mass.*	1904
DAY, ARTHUR L	*Corning Glass Works, Corning, N. Y.*	1911
DEWEY, JOHN	*Columbia University, New York City.*	1910
DICKSON, LEONARD E	*University of Chicago, Chicago, Ill.*	1913
DONALDSON, HENRY HERBERT	*Wistar Institute of Anatomy, Phila., Pa.*	1914
DUNN, GANO	*43 Exchange Place, New York City.*	1919
DURAND, WILLIAM FREDERICK	*Leland Stanford University, Calif.*	1917
ELKIN, WILLIAM L	*Yale University Observatory, New Haven, Conn.*	1895
FEWKES, JESSE WALTER	*Bureau of American Ethnology, Wash., D. C.*	1914
FLEXNER, SIMON	*Rockefeller Institute, New York City.*	1908
FOLIN, OTTO	*Harvard Medical School, Boston, Mass.*	1916
FORBES, STEPHEN ALFRED	*Urbana, Ill.*	1918
FRANKLIN, EDWARD CURTIS	*Stanford University, California.*	1914
FREEMAN, JOHN RIPLEY	*Providence, R. I.*	1918
FROST, EDWIN B	*Yerkes Observatory, Williams Bay, Wis.*	1908
GOMBERG, MOSES	*University of Michigan, Ann Arbor, Mich.*	1914
GOOCH, FRANK A	*291 Edwards St., New Haven, Conn.*	1897
GOODALE, GEORGE L	*Harvard University, Cambridge, Mass.*	1890
HALE, GEORGE E	*Solar Observatory Office, Pasadena, Calif.*	1902
HALL, EDWIN H	*Harvard University, Cambridge, Mass.*	1911
HALL, GRANVILLE STANLEY	*Clark University, Worcester, Mass.*	1915
HALSTED, WILLIAM STEWART	*Johns Hopkins Med. School, Baltimore, Md.*	1917
HARPER, R. A	*Columbia University, New York City.*	1911
HARRISON, ROSS G	*Yale University, New Haven, Conn.*	1913
HASTINGS, CHARLES S	*Yale University, New Haven, Conn.*	1889
HAYFORD, JOHN F	*Northwestern University, Evanston, Ill.*	1911
HEKTOEN, LUDVIG	*629 South Wood St., Chicago, Ill.*	1918
HENDERSON, LAWRENCE JOSEPH	*Harvard University, Cambridge, Mass.*	1919
HERRICK, CHARLES JUDSON	*University of Chicago, Chicago, Ill.*	1918
HILLEBRAND, WILLIAM F	*Bureau of Standards, Washington, D. C.*	1908
HOLMES, WILLIAM H	*U. S. National Museum, Washington, D. C.*	1905
HOWARD, LELAND OSSIAN	*U. S. Dept. of Agriculture, Washington, D. C.*	1916
HOWE, HENRY MARION	*Broad Brook Road, Bedford Hills, N. Y.*	1917
HOWELL, WILLIAM H	*School of Hygiene and Public Health, Baltimore, Md.*	1905
HUNT, REID	*Harvard Medical School, Boston, Mass.*	1919
IDDINGS, JOSEPH P	*U. S. Geological Survey, Washington, D. C.*	1907
JACKSON, CHARLES L	*383 Beacon St., Boston, Mass.*	1883
JENNINGS, HERBERT SPENCER	*Johns Hopkins University, Baltimore, Md.*	1914
JEWETT, FRANK BALDWIN	*Western Electric Co., New York, N. Y.*	1918
JOHNSON, TREAT BALDWIN	*Yale University, New Haven, Conn.*	1919
JONES, WALTER	*Johns Hopkins University, Baltimore, Md.*	1918
KASNER, EDWARD	*Columbia University, New York City.*	1917
KEMP, JAMES F	*Columbia University, New York City.*	1911
LANGMUIR, IRVING	*Gen. Electric Co., Schenectady, N. Y.*	1918
LEUSCHNER, ARMIN O	*University of California, Berkeley, Calif.*	1913
LEVENE, PHŒBUS AARON THEODOR	*Rockefeller Institute, New York City.*	1916
LEWIS, GILBERT N	*University of California, Berkeley, Calif.*	1913
LILLIE, FRANK RATTRAY	*University of Chicago, Chicago, Ill.*	1915
LINDGREN, WALDEMAR	*Mass. Inst. of Technology, Cambridge, Mass.*	1909

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		Date of election.
LOEB, JACQUES	*Rockefeller Institute, New York City.*	1910
LUSK, GRAHAM	*Cornell University Medical College, New York City.*	1915
LYMAN, THEODORE	*Harvard University, Cambridge, Mass.*	1917
MARK, EDWARD L	*109 Irving St., Cambridge, Mass.*	1903
MAYOR, ALFRED GOLDSBOROUGH	*276 Nassau St., Princeton, N. J.*	1916
MELTZER, SAMUEL JAMES	*Rockefeller Institute, New York City.*	1912
MENDEL, LAFAYETTE B	*262 Canner St., New Haven, Conn.*	1913
MENDENHALL, CHARLES ELWOOD	*University of Wisconsin, Madison, Wis.*	1918
MENDENHALL, THOMAS C	*329 North Chestnut St., Ravenna, Ohio.*	1887
MERRIAM, C. HART	*1919 16th St., Washington, D. C.*	1902
MERRIAM, JOHN CAMPBELL	*University of California, Berkeley, Calif.*	1918
MERRITT, ERNEST	*Cornell University, Ithaca, N. Y.*	1914
MICHAEL, ARTHUR	*219 Parker St., Newton Center, Mass.*	1889
MICHELSON, ALBERT A	*University of Chicago, Chicago, Ill.*	1888
MILLIKAN, ROBERT ANDREWS	*University of Chicago, Chicago, Ill.*	1915
MOORE, ELIAKIM H	*University of Chicago, Chicago, Ill.*	1901
MORGAN, T. H	*Columbia University, New York City.*	1909
MORLEY, EDWARD W	*West Hartford, Conn.*	1897
MORSE, EDWARD S	*Salem, Mass.*	1876
MORSE, HARMON N	*Johns Hopkins University, Baltimore, Md.*	1907
MOULTON, F. R	*University of Chicago, Chicago, Ill.*	1919
NICHOLS, EDWARD L	*Cornell University, Ithaca, N. Y.*	1901
NICHOLS, ERNEST F	*Yale University, New Haven, Conn.*	1908
NOYES, ARTHUR A	*Mass. Inst. of Technology, Cambridge, Mass.*	1905
NOYES, WILLIAM A	*University of Illinois, Urbana, Ill.*	1910
OSBORN, H. F	*American Museum of Natural History, New York City.*	1900
OSBORNE, T. B	*Agricultural Experiment Station, New Haven, Conn.*	1910
OSGOOD, WILLIAM FOGG	*Harvard University, Cambridge, Mass.*	1904
OSTERHOUT, WINTHROP JOHN VANLEUVEN	*Harvard Univ., Cambridge, Mass.*	1919
PARKER, GEORGE H	*16 Berkeley St., Cambridge, Mass.*	1913
PEARL, RAYMOND	*625 St. Paul St., Baltimore, Md.*	1916
PEUDDEN, T. MITCHELL	*Columbia University, New York City.*	1901
PUMPELLY, RAPHAEL	*Gibbs Avenue, Newport, R. I.*	1872
PUPIN, MICHAEL I	*Columbia University, New York City.*	1905
RANSOME, FREDERICK LESLIE	*U. S. Geological Survey, Washington, D. C.*	1914
REID, H. FIELDING	*Johns Hopkins University, Baltimore, Md.*	1912
REMSEN, IRA	*Johns Hopkins University, Baltimore, Md.*	1882
RICHARDS, THEODORE W	*Wolcott Gibbs Mem. Lab., Cambridge, Mass.*	1899
RIDGWAY, ROBERT	*1030 South Morgan St., Olney, Ill.*	1917
ROSA, EDWARD B	*Bureau of Standards, Washington, D. C.*	1913
RUSSELL, HENRY NORRIS	*Princeton University, Princeton, N. J.*	1918
SARGENT, CHARLES S	*Arnold Arboretum, Jamaica Plain, Mass.*	1895
SCHLESINGER, FRANK	*Allegheny Observatory, Allegheny, Pa.*	1916
SCHUCHERT, CHARLES	*Yale University, New Haven, Conn.*	1910
SCOTT, WILLIAM B	*Princeton University, Princeton, N. J.*	1906
SEARES, FREDERICK HANLEY	*Mount Wilson Observatory, Pasadena, Calif.*	1919
SETCHELL, WILLIAM ALBERT	*University of California, Berkeley, Calif.*	1919
SMITH, ALEXANDER	*Columbia University, New York City.*	1915
SMITH, EDGAR F	*University of Pennsylvania, Philadelphia, Pa.*	1899
SMITH, ERWIN F	*Bureau of Plant Industry, Washington, D. C.*	1913
SMITH, THEOBALD	*Princeton, N. J.*	1908
SQUIER, GEORGE OWEN	*Chief Signal Officer U. S. Army, Washington, D. C.*	1919

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		Date of election.
STIEGLITZ, JULIUS	*University of Chicago, Chicago, Ill.*	1911
STORY, WILLIAM E	*Clark University, Worcester, Mass.*	1908
STRATTON, SAMUEL WESLEY	*Bureau of Standards, Washington, D. C.*	1917
TAYLOR, DAVID WATSON	*Department of the Navy, Washington, D. C.*	1918
THAXTER, ROLAND	*Harvard University, Cambridge, Mass.*	1912
THOMSON, ELIHU	*Swampscott, Mass.*	1907
THORNDIKE, EDWARD LEE	*Columbia University, New York City.*	1917
TRELEASE, WILLIAM	*University of Illinois, Urbana, Ill.*	1902
TROWBRIDGE, AGUSTUS	*Princeton University, Princeton, N. J.*	1919
TROWBRIDGE, JOHN	*Harvard University, Cambridge, Mass.*	1878
ULRICH, EDWARD OSCAR	*U. S. Geological Survey, Washington, D. C.*	1917
VAN VLECK, E. B.	*University of Wisconsin, Madison, Wis.*	1911
VAUGHAN, VICTOR CLARENCE	*University of Michigan, Ann Arbor, Mich.*	1915
VEBLEN, OSWALD	*Princeton University, Princeton, N. J.*	1919
VERRILL, A. E	*53 Rolston St., Whitneyville, Conn.*	1872
WALCOTT, CHARLES D	*Smithsonian Institution, Washington, D. C.*	1896
WEBSTER, ARTHUR G	*Clark University, Worcester, Mass.*	1903
WELCH, WILLIAM H	*807 St. Paul St., Baltimore, Md.*	1895
WELLS, HORACE L	*Yale University, New Haven, Conn.*	1903
WHEELER, WILLIAM M	*Harvard University, Cambridge, Mass.*	1912
WHITE, DAVID	*U. S. Geological Survey, Washington, D. C.*	1912
WHITE, HENRY SEELY	*Vassar College, Poughkeepsie, N. Y.*	1915
WHITNEY, WILLIS RODNEY	*General Electric Co., Schenectady, N. Y.*	1917
WILCZYNSKI, ERNEST JULIUS	*University of Chicago, Chicago, Ill.*	1919
WILSON, EDMUND B	*Columbia University, New York City.*	1899
WILSON, EDWIN BIDWELL	*Mass. Institute Technology, Cambridge, Mass.*	1919
WOOD, HORATIO C	*4107 Chester Avenue, Philadelphia, Pa.*	1879
WOOD, ROBERT W	*Johns Hopkins University, Baltimore, Md.*	1912
WOODWARD, ROBERT S	*Carnegie Institution, Washington, D. C.*	1896

HONORARY MEMBERS.

SMITH, SIDNEY I	*Yale University, New Haven, Conn.*	1884

FOREIGN ASSOCIATES.

ARRHENIUS, S. A	*Nobelinstitut, Stockholm.*	1908
BARROIS, CHARLES	*Université, Lille.*	1908
BRØGGER, W. C	*Universitet, Christiania.*	1903
DE VRIES, HUGO	*Universiteit, Amsterdam.*	1904
DESLANDRES, HENRI	*Astrophysical Observatory, Meudon.*	1913
DEWAR, SIR JAMES	*University, Cambridge.*	1907
FORSYTH, A. R	*Imperial College of Science and Technology, London.*	1907
GEIKIE, SIR ARCHIBALD	*Haslemere, Surrey.*	1901
GROTH, PAUL VON	*Universität, Munich.*	1905
HEIM, ALBERT	*Zürich.*	1913
HILBERT, DAVID	*Universität, Göttingen.*	1907
KAPTEYN, JOHN C	*Rijks Universiteit, Groningen.*	1907
KLEIN, FELIX	*Univesität, Göttingen.*	1898
KÖSSEL, ALBRECHT	*Heidelberg.*	1913
KUSTNER, KARL FRIEDRICH	*Bonn.*	1913
LANKESTER, SIR E. RAY	*South Kensington, London.*	1903
LARMOR, SIR JOSEPH	*St. Johns College, Cambridge.*	1908
LORENTZ, HENDRIK ANTON	*Rijks Universiteit, Leiden.*	1906

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		Date of election.
OSTWALD, WILHELM	*Grossbothen, bei Leipzig.*	1905
PENCK, ALBRECHT	*Universität, Berlin.*	1909
PFEFFER, WILHELM	*Botanische Institut der Universität, Leipzig.*	1905
PICARD, CHARLES ÉMILE	*Université, Paris.*	1903
RUTHERFORD, SIR ERNEST	*University, Manchester.*	1911
SCHUSTER, ARTHUR	*Secretary of the Royal Society, London.*	1913
SEELIGER, HUGO RITTER VON	*Universität, Munich.*	1908
THOMSON, SIR JOSEPH	*University, Cambridge.*	1903
VOLTERRA, VITO	*Università, Rome.*	1911
VAN DER WAALS, JOHANNES D	*Amsterdam.*	1913
WALDEYER, WILHELM	*Universität, Berlin.*	1909
WOLF, MAX F. J. C	*Heidelberg.*	1913
WUNDT, WILHELM	*Universität, Leipzig.*	1909

DECEASED MEMBERS.

	Date of election.	Date of death.
ABBE, CLEVELAND	1878	Oct. 28, 1916
AGASSIZ, ALEXANDER	1866	Mar. 27, 1910
AGASSIZ, LOUIS	(1)	Dec. 14, 1873
ATKINSON, GEORGE FRANCIS	1918[2]	Nov. 14, 1918
ALEXANDER, J. H.	(1)	Mar. 2, 1867
ALEXANDER, STEPHEN	(1)	June 25, 1883
BACHE, ALEXANDER DALLAS	(1)	Feb. 14, 1867
BAIRD, SPENCER F.	1864	Aug. 19, 1887
BARKER, GEORGE F.	1876[2]	May 24, 1910
BARNARD, F. A. P.	(1) (2)	Apr. 27, 1889
BARNARD, J. G.	(1)	May 14, 1882
BARRELL, JOSEPH	1919[2]	May 4, 1919
BARTLETT, W. H. C.	(1)	Feb. 11, 1883
BECKER, GEORGE FERDINAND	1901[2]	Apr. 20, 1919
BEECHER, CHARLES EMERSON	1899	Feb. 14, 1904
BILLINGS, JOHN S.	1883	Mar. 11, 1913
BÔCHER, MAXIME	1909[2]	Sept. 12, 1918
BOSS, LEWIS	1889	Oct. 5, 1912
BOWDITCH, HENRY P.	1887[2]	Mar. 13, 1911
BREWER, WILLIAM H.	1880[2]	Nov. 2, 1910
BROOKS, WILLIAM KEITH	1884	Nov. 12, 1908
BROWN-SEQUARD, CHARLES E.	1868	Apr. 2, 1894
BRUSH, GEORGE JARVIS	1868[2]	Feb. 6, 1912
CASEY, THOMAS L.	1890	Mar. 25, 1896
CASWELL, ALEXIS	(1)	Jan. 8, 1877
CHANDLER, SETH CARLO	1888[2]	Dec. 31, 1913
CHAUVENET, WILLIAM	(1)	Dec. 13, 1870
CLARK, HENRY JAMES	1872	July 1, 1873
CLARK, WILLIAM B.	1908	July 27, 1917
COFFIN, JAMES H.	1869	Feb. 6, 1873
COFFIN, J. H. C.	(1)	Jan. 8, 1890
COMSTOCK, CYRUS B.	1884	May 29, 1910
COOK, GEORGE H.	1887	Sept. 22, 1889
COOKE, JOSIAH P.	1872	Sept. 3, 1894
COPE, EDWARD D.	1872[2]	Apr. 12, 1897
COUES, ELLIOTT	1877	Dec. 25, 1899
CRAFTS, JAMES M.	1872	June 21, 191

[1] Charter members, Mar. 3, 1863. [2] Biographical memoirs have not been presented.

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	Date of election.	Date of death.
DALTON, J. C.	1864	Feb. 2, 1889
DANA, JAMES D.	(1)	Apr. 14, 1895
DAVIDSON, GEORGE	1874 [2]	Dec. 2, 1911
DAVIS, CHARLES H.	(1)	Feb. 18, 1877
DRAPER, HENRY	1877	Nov. 20, 1882
DRAPER, JOHN W.	1877	Jan. 4, 1882
DUTTON, C. E.	1884 [2]	Jan. 4, 1912
EADS, JAMES B.	1872	Mar. 8, 1887
EMMONS, SAMUEL F.	1892	Mar. 28, 1911
ENGLEMANN, GEORGE	(1)	Feb. 4, 1884
FARLOW, W. G.	1879 [2]	June 3, 1919
FERREL, WILLIAM	1868	Sept. 18, 1891
FRASER, JOHN FRIES	(1)	Oct. 12, 1872
GABB, WILLIAM M.	1876	May 30, 1878
GENTH, F. A.	1872	Feb. 2, 1893
GIBBS, JOSIAH WILLARD	1879	Apr. 28, 1903
GIBBS, WOLCOTT	(1)	Dec. 9, 1908
GILBERT, GROVE KARL	1883 [2]	May 1, 1918
GILL, THEODORE NICHOLAS	1873	Sept. 25, 1914
GILLISS, JAMES MELVILLE	(1)	Feb. 9, 1865
GOODE, G. BROWN	1888	Sept. 6, 1896
GOULD, AUGUSTUS A.	(1)	Sept. 15, 1866
GOULD, BENJAMIN A.	(1) (2)	Nov. 26, 1896
GRAY, ASA	(1)	Jan. 30, 1888
GUYOT, ARNOLD	(1)	Feb. 8, 1884
HADLEY, JAMES	1872	Nov. 14, 1872
HAGUE, ARNOLD	1885	May 15, 1917
HALDEMAN, S. S.	1876	Sept. 20, 1880
HALL, ASAPH	1875	Nov. 22, 1907
HALL, JAMES	(1) (2)	Aug. 7, 1898
HAYDEN, F. V.	1873	Dec. 22, 1887
HENRY, JOSEPH	(1)	May 13, 1878
HILGARD, EUGENE W.	1872	Jan. 8, 1916
HILGARD, JULIUS E.	(1)	May 9, 1890
HILL, GEORGE WILLIAM	1874	Apr. 16, 1914
HILL, HENRY B.	1883	Apr. 6, 1908
HITCHCOCK, EDWARD	(1)	Feb. 27, 1864
HOLBROOK, J. E.	1868	Sept. 8, 1871
HOLDEN, EDWARD SINGLETON	1885	Mar. 16, 1914
HUBBARD, J. S.	(1)	Aug. 16, 1863
HUMPHREYS, A. A.	(1)	Dec. 27, 1883
HUNT, T. STERY	1873 [2]	Feb. 12, 1892
HYATT, ALPHEUS	1875	Jan. 15, 1902
JAMES, WILLIAM [2]	1903	Aug. 26, 1910
JOHNSON, S. W.	1866	July 21, 1909
KEELER, J. E.	1900	Aug. 12, 1900
KING, CLARENCE	1876	Dec. 24, 1901
KIRTLAND, JARED P.	1865	Dec. 10, 1877
LANE, J. HOMER	1872	May 3, 1880
LANGLEY, SAMUEL P.	1876	Feb. 27, 1906
LEA, MATTHEW CAREY	1892	Mar. 15, 1897
LE CONTE, JOHN	1878	Apr. 29, 1891
LE CONTE, JOHN L.	(1)	Nov. 15, 1883
LE CONTE, JOSEPH	1875	July 6, 1901

[1] Charter members, Mar. 3, 1863.

[2] Biographical memoirs have not been presented.

[3] Resigned in 1908 or 1909.

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	Date of election.	Date of death.
LEIDY, JOSEPH	[1]	Apr. 30, 1891
LESLEY, J. PETER	[1]	June 1, 1903
LESQUEREUX, LEO	1864	Oct. 20, 1889
LONGSTRETH, MIERS F	[1]	Dec. 27, 1891
LOOMIS, ELIAS	1873	Aug. 15, 1889
LOVERING, JOSEPH	1873	Jan. 18, 1892
LYMAN, THEODORE	1872	Sept. 9, 1897
MAHAN, D. H	[1]	Sept. 16, 1871
MALL, FRANKLIN P	1907 [2]	Nov. 17, 1917
MARSH, G. P	1866	July 23, 1882
MARSH, O. C	1874 [2]	Mar. 18, 1899
MAYER, ALFRED M	1872	July 13, 1897
MEEK, F. B	1869	Dec. 21, 1876
MEIGS, M. C	1865	Jan. 2, 1892
MINOT, CHARLES SEDGWICK	1897 [2]	Nov. 19, 1914
MITCHELL, HENRY	1885 [2]	Dec. 1, 1902
MITCHELL, SILAS WEIR	1865	Jan. 4, 1914
MORGAN, LEWIS H	1875	Dec. 17, 1881
MORTON, HENRY	1874	May 9, 1902
NEF, JOHN ULRIC	1904 [2]	Aug. 13, 1915
NEWBERRY, J. S	[1]	Dec. 7, 1892
NEWCOMB, SIMON	1869 [2]	July 11, 1909
NEWTON, H. A	[1]	Aug. 12, 1895
NEWTON, JOHN	1876	May 1, 1896
NORTON, WILLIAM A	1873	Sept. 21, 1883
OLIVER, JAMES E	1872	Mar. 27, 1895
PACKARD, A. S	1872	Feb. 14, 1905
PENFIELD, SAMUEL L	1900	Aug. 13, 1906
PETERS, C. H. F	1876 [2]	July 18, 1890
PEIRCE, BENJAMIN [3]	[1][3]	Oct. 6, 1880
PEIRCE, BENJAMIN OSGOOD	1906	Jan. 14, 1914
PICKERING, EDWARD C	1873 [2]	Feb. 3, 1919
PIERCE, CHARLES SANTIAGO SANDERS	1876 [2]	Apr. 20, 1914
PIRSSON, LOUIS V	1913 [2]	Dec. 8, 1919
POURTALES, L. F	1873	July 19, 1880
POWELL, JOHN W	1880	Sept. 23, 1902
PUTNAM, FREDERICK W	1885 [2]	Aug. 18, 1915
RODGERS, JOHN	[1]	May 5, 1882
ROGERS, FAIRMAN	[1]	Aug. 22, 1900
ROGERS, ROBERT E. [4]	[1]	Sept. 6, 1884
ROGERS, WILLIAM A	1885	Mar. 1, 1896
ROGERS, WILLIAM B. [5]	[1]	May 30, 1882
ROOD, OGDEN N	1865	Nov. 12, 1902
ROWLAND, HENRY A	1881	Apr. 16, 1901
ROYCE, JOSIAH	1906 [2]	Sept. 14, 1916
RUTHERFURD, LEWIS M	[1]	May 30, 1892
SABINE, WALLACE C. W	1917 [2]	Jan. 10, 1919
SAXTON, JOSEPH	[1]	Oct. 26, 1873
SCHOTT, CHARLES A	1872	July 31, 1901
SCUDDER, SAMUEL H	1877 [2]	May 17, 1911
SELLERS, WILLIAM	1873 [2]	Jan. 24, 1905
SILLIMAN, BENJ., Sr	[1]	Nov. 24, 1864
SILLIMAN, BENJ., Jr	[1]	Jan. 14, 1885
SMITH, J. LAWRENCE	1872	Oct. 12, 1883
SMITH, RICHMOND MAYO	1890 [2]	Nov. 11, 1901

[1] Charter members, Mar. 3, 1863.
[2] Biographical memoirs have not been presented
[3] Resigned 1873.
[4] Dropped —, reelected 1875.
[5] Dropped —, reelected 1872.

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	Date of election.	Date of death.
Stimpson, William	1868	May 26, 1872
Strong, Theodore	(1)	Feb. 1, 1869
Sullivant, W. S	1872	Apr. 30, 1873
Torrey, John	(1)	Mar. 10, 1873
Totten, J. G	(1)	Apr. 22, 1864
Trowbridge, William P	1872	Aug. 12, 1892
Trumbull, James H	1872	Aug. 5, 1897
Tuckerman, Edward	1868	Mar. 15, 1886
Van Hise, C. R	1902 [2]	Nov. 19, 1918
Walker, Francis A	1878	Jan. 5, 1897
Warren, G. K	1876	Aug. 8, 1882
Watson, James C	1868	Nov. 23, 1880
Watson, Sereno	1889	Mar. 9, 1892
Wheeler, Henry Lord	1909 [2]	Oct. 30, 1914
White, Charles A	1889	June 29, 1910
Whitman, C. O	1895	Dec. 6, 1910
Whitney, Josiah D. [3]	(1) (3)	Aug. 19, 1896
Whitney, William D. [3]	1865 [3]	June 29, 1894
Williston, Samuel Wendell	1915 [2]	Aug. 30, 1918
Winlock, Joseph	(1)	June 11, 1875
Woodward, J. J	1873	Aug. 17, 1884
Worthen, A. H	1872	May 6, 1888
Wright, Arthur Williams	1881 [2]	Dec. 19, 1915
Wyman, Jeffries	(1)	Sept. 4, 1874
Young, Charles A	1872	Jan. 3, 1908

[1] Charter members, Mar. 3, 1863. [2] Biographical memoirs have not been presented. [3] Resigned.

DECEASED FOREIGN ASSOCIATES.

Adams, J. C.
Airy, Sir George B.
Argelander, F. W. A.
Auwers, G. F. J. Arthur
Backlund, Oskar
Baer, Karl Ernest von
Baeyer, Adolf von
Barrande, Joachin
Beaumont, L. Élie de
Becquerel, Henri
Berthelot, M. P. E.
Bertrand, J. L. F.
Boltzmann, Ludwig
Bornet, Edouard
Boussingault, J. B. J. D.
Boveri, Theodor
Braun, Alexander
Brewster, Sir David
Bunsen, Robert W.
Burmeister, C. H. C.
Candolle, Alphonse de
Cayley, Arthur
Chasles, Michel
Chevreul, M. E.
Clausius, Rudolph
Cornu, Alfred
Crookes, Sir William
Darboux, Gaston
Darwin, Sir George Howard
Dove, H. W.
Dumas, J. B.
Ehrlich, Paul
Faraday, Michael
Fischer, Emil
Gegenbaur, Karl,
Glydén, Hugo
Gill, Sir David
Hamilton, Sir William Rowan
Helmholtz, Baron H. von
Hoff, J. H. van't
Hofmann, A. W.
Hooker, Sir Joseph D.
Huggins, Sir William
Huxley, T. H.

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IBAÑEZ, CARLOS
JANSSEN, J.
JOULE, JAMES P.
KEKULÉ, AUGUST
KELVIN, LORD
KIRCHOFF, G. R.
KOCH, ROBERT
KÖLLIKER, ALBERT VON
KOHLRAUSCH, FRIEDRICH
KRONECKER, HUGO
LACAZE-DUTHIERS, HENRI DE
LEUCKART, RUDOLPH
LIE, SOPHUS,
LIEBIG, JUSTUS VON
LISTER, LORD
LOEWY, MAURICE
LUDWIG, K. F. W.
MAREY, E. J.
MENDELÉEFF, D. I.
MILNE-EDWARDS, HENRI
MOISSAN, HENRI
MURCHISON, SIR RODERICK I.
MURRAY, SIR JOHN
OPPOLZER, THEODORE VON
OWEN, SIR RICHARD
PASTEUR, LOUIS
PAVLOV, IVAN PETROVITCH
PETERS, C. A. F.
PLANA, G. A. A.
POINCARÉ, JULES HENRI
RAMMELSBERG, C. F.
RAMSAY, SIR WILLIAM
RAYLEIGH, LORD
REGNAULT, VICTOR
RETZIUS, GUSTAV
REYMOND, EMIL DU BOIS
RICHTHOFEN, F. VON
ROSENBUSCH, KARL HARRY FERDINAND
SACHS, JULIUS VON
SCHIAPARELLI, GIOVANNI
STAS, JEAN SERVAIS
STOKES, SIR GEORGE G.
STRASBURGER, EDOUARD
STRUVE, OTTO VON
SUESS, EDUARD
SYLVESTER, J. J.
TISSERAND, F. F.
VIRCHOW, RUDOLPH VON
VOGEL, H. C.
WEIERSTRASS, KARL
WEISMANN, AUGUST
WÖHLER, FRIEDRICH
WÜRTZ, ADOLPH
ZIRKEL, FERDINAND
ZITTELL, K. A. R. VON

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REPORT

OF THE

NATIONAL ACADEMY OF SCIENCES

FOR THE YEAR

1920

WASHINGTON
GOVERNMENT PRINTING OFFICE
1921

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REPORT

OF THE

NATIONAL ACADEMY OF SCIENCES

FOR THE YEAR

1920

WASHINGTON
GOVERNMENT PRINTING OFFICE
1921

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CONTENTS.

	Page.
Letter of transmittal	7
Act of incorporation	8
Amendments	9
Meetings of the National Academy of Sciences	11
Annual meeting	11
Members in attendance	11
Business sessions	12
Assignment of biographies	12
Changes in personnel of sections and committees	12
Delegates	12
Report of the treasurer	12
Report of the home secretary	12
Report of the directors of the Bache fund	13
Report of the committee on the Henry Draper fund	15
Report of the trustees of the Watson fund	16
Report of the J. Lawrence Smith fund	17
Report of the directors of the Gould fund	18
Report of the committee on the Murray fund	18
Report of the committee on the Barnard medal	18
Report of the directors of the Wolcott Gibbs fund	18
Report of the committee on the Marsh fund	19
Report of the committee on the Daniel Giraud Elliot fund	19
Recommendations from the council	19
Amendments to the constitution	19
Amendments to rules	20
Conservation of natural resources	20
Resignation—E. W. Morley	20
Decision of the Attorney General	20
Election of officers and members	25
Scientific sessions	25
April 26	25
April 27	26
Presentation of medals	27
Henry Draper medal	27
Medal for eminence in application of science to the public welfare	27
Autumn meeting	27
Members in attendance	27
Business sessions	28
Assignment of biographies	28
Changes in personnel	28
Appointment of delegates	28
Amendments to the constitution	28
Amendment to rules	28
International Research Council	29

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Meetings of the National Academy of Sciences—Continued.
Autumn meeting—Continued.
Business sessions—Continued. Page.
Medal for eminence in the application of science to the public welfare ... 29
Science News Service ... 29
Report of committee on the conservation of natural resources ... 30
Report of committee on the Mary Clark Thompson medal ... 31
Report of trustees of the Watson fund ... 31
Resolutions on the death of Theodore N. Vail ... 31
Scientific sessions ... 32
November 16 ... 32
November 17 ... 32
Business of the Council ... 33
Proceedings ... 33
Fifth annual report of the National Research Council ... 34
General policies and organization ... 34
Relations to the National Academy of Sciences ... 36
Relations to the Engineering Foundation ... 37
Financial support and gifts ... 37
Publications ... 40
Publicity ... 42
Science Service ... 43
Industrial personnel research ... 43
International Catalogue of Scientific Literature ... 44
International auxiliary language ... 45
Abstracting and listing scientific literature ... 46
Intelligence tests for elementary schools ... 47
Pacific exploration ... 48
American Geophysical Union ... 48
Death of Chairman H. A. Bumstead ... 49
Reports of divisions ... 50
Divisions of general relations ... 50
Division of Federal relations ... 50
Division of foreign relations ... 51
Division of States relations ... 52
Division of educational relations ... 53
Division of research extension ... 54
Research information service ... 59
Divisions of science and technology ... 63
Division of physical sciences ... 63
Division of engineering ... 64
Division of chemistry and chemical technology ... 70
Division of geology and geography ... 73
Division of biology and agriculture ... 76
Division of medical sciences ... 80
Division of anthropology and psychology ... 82
Appendix A ... 84
Officers, members, and committees ... 84
Divisions of the council ... 86
Division of Federal relations ... 86
Division of foreign relations ... 88
Division of States relations ... 90
Division of educational relations ... 91

Digitized by Google

Meetings of the National Academy of Science—Continued.
Fifth annual report of the National Research Council—Continued.
Appendix A—Continued.
Divisions of the council—Continued. Page.
Division of research extension ... 92
Research information service ... 93
Division of physical sciences ... 94
Division of engineering ... 96
Division of chemistry and chemical technology ... 99
Division of geology and geography ... 101
Division of medical sciences ... 102
Division of biology and agriculture ... 103
Division of anthropology and psychology ... 106
Research fellowship board ... 107
Appendix B ... 108
Articles of organization ... 108
Annual report of the treasurer ... 111
General review of financial transactions ... 111
National Academy of Sciences ... 111
Trust funds of the Academy ... 112
Statement of assets and liabilities ... 114
Statement of receipts and expenditures ... 116
Accounts with individual funds ... 118
National Research Council ... 124
Receipts and disbursements ... 125
Report of the auditing committee ... 128
Deceased members ... 129
Louis Valentine Pirsson ... 129
Joseph Paxton Iddings ... 140
Samuel James Meltzer ... 141
Harmon Northrup Morse ... 142
Horatio C. Wood ... 146
Deceased foreign associate ... 147
Wilhelm Wundt ... 147
Appendixes ... 151
Appendix A—Constitution of the National Academy of Sciences ... 153
Appendix B—Rules ... 160
Appendix C—Organization of the Academy, 1920–1921 ... 166
Sections ... 166
Standing committees ... 168
Trust funds ... 168
Members of the National Academy of Sciences, December 31, 1920 ... 171
Honorary member ... 174
Foreign associates ... 174
Deceased members ... 175
Deceased foreign associates ... 176

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LETTER OF TRANSMITTAL.

NATIONAL ACADEMY OF SCIENCES,
Washington, D. C., February 4, 1921.

SIR: I have the honor to transmit to you herewith the annual report of the president of the National Academy of Sciences for the year ending December 31, 1920.

Very respectfully,

CHARLES D. WALCOTT, *President.*

Hon. THOMAS R. MARSHALL,
Vice President of the United States.

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ACT OF INCORPORATION.

AN ACT To incorporate the National Academy of Sciences.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That Louis Agassiz, Massachusetts; J. H. Alexander, Maryland; S. Alexander, New Jersey; A. D. Bache, at large; F. B. Barnard,[1] at large; J. G. Barnard, United States Army, Massachusetts; W. H. C. Bartlett, United States Military Academy, Missouri; U. A. Boyden,[2] Massachusetts; Alexis Caswell, Rhode Island; William Chauvenet, Missouri; J. H. C. Coffin, United States Naval Academy, Maine; J. A. Dahlgren,[2] United States Navy, Pennsylvania; J. D. Dana, Connecticut; Charles H. Davis, United States Navy, Massachusetts; George Englemann, Saint Louis, Missouri; J. F. Frazer, Pennsylvania; Wolcott Gibbs, New York; J. M. Giles,[3] United States Navy, District of Columbia; A. A. Gould, Massachusetts; B. A. Gould, Massachusetts; Asa Gray, Massachusetts; A. Guyot, New Jersey; James Hall, New York; Joseph Henry, at large; J. E. Hilgard, at large, Illinois; Edward Hitchcock, Massachusetts; J. S. Hubbard, United States Naval Observatory, Connecticut; A. A. Humphreys, United States Army, Pennsylvania; J. L. Le Conte, United States Army, Pennsylvania; J. Leidy, Pennsylvania; J. P. Lesley, Pennsylvania; M. F. Longstreth, Pennsylvania; D. H. Mahan, United States Military Academy, Virginia; J. S. Newberry, Ohio; H. A. Newton, Connecticut; Benjamin Peirce, Massachusetts; John Rodgers, United States Navy, Indiana; Fairman Rogers, Pennsylvania; R. E. Rogers, Pennsylvania; W. B. Rogers, Massachusetts; L. M. Rutherford, New York; Joseph Saxton, at large; Benjamin Silliman, Connecticut; Benjamin Silliman, junior, Connecticut; Theodore Strong, New Jersey; John Torrey, New York; J. G. Totten, United States Army, Connecticut; Joseph Winlock, United States Nautical Almanac, Kentucky; Jeffries Wyman, Massachusetts; J. D. Whitney, California; their associates and successors duly chosen, are hereby incorporated, constituted, and declared to be a body corporate, by the name of the National Academy of Sciences.

SEC. 2. *And be it further enacted*, That the National Academy of Sciences shall consist of not more than fifty ordinary members, and the said corporation hereby constituted shall have power to make its

[1] The official list of members gives the name of F. A. P. Barnard.
[2] Declined.
[3] The official list of members gives the name of J. M. Gillis.

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own organization, including its constitution, by-laws, and rules and regulations; to fill all vacancies created by death, resignation, or otherwise; to provide for the election of foreign and domestic members, the division into classes, and all other matters needful or usual in such institution, and to report the same to Congress.

SEC. 3. *And be it further enacted*, That the National Academy of Sciences shall hold an annual meeting at such place in the United States as may be designated, and the Academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art, the actual expense of such investigations, examinations, experiments, and reports to be paid from appropriations which may be made for the purpose, but the Academy shall receive no compensation whatever for any services to the Government of the United States.

SOLOMON FOOTE,
President of the Senate pro tempore.
GALUSHA A. GROW,
Speaker of the House of Representatives.

Approved, March 3, 1863.

ABRAHAM LINCOLN, *President.*

AMENDMENTS.

AN ACT To amend the act to incorporate the National Academy of Sciences.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the act to incorporate the National Academy of Sciences, approved March third, eighteen hundred and sixty-three, be, and the same is hereby, so amended as to remove the limitation of the number of ordinary members of said Academy as provided in said act.

Approved, July 14, 1870.

AN ACT To authorize the National Academy of Sciences to receive and hold trust funds for the promotion of science, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the National Academy of Sciences, incorporated by the act of Congress, approved March third, eighteen hundred and sixty-three, and its several supplements, be, and the same is hereby, authorized and empowered to receive bequests and donations and hold the same in trust, to be applied by the said Academy in aid of scientific investigations and according to the will of the donors.

Approved, June 20, 1884.

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AN ACT To amend the act authorizing the National Academy of Sciences to receive and hold trust funds for the promotion of science, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the act to authorize the National Academy of Sciences to receive and hold trust funds for the promotion of science, and for other purposes, approved June twentieth, eighteen hundred and eighty-four, be, and the same is hereby, amended to read as follows:

"That the National Academy of Sciences, incorporated by the act of Congress approved March third, eighteen hundred and sixty-three, be, and the same is hereby, authorized and empowered to receive, by devise, bequest, donation, or otherwise, either real or personal property, and to hold the same absolutely or in trust, and to invest, reinvest, and manage the same in accordance with the provisions of its constitution, and to apply said property and the income arising therefrom to the objects of its creation and according to the instructions of the donors: *Provided, however*, That the Congress may at any time limit the amount of real estate which may be acquired and the length of time the same may be held by said National Academy of Sciences."

SEC. 2. That the right to alter, amend, or repeal this act is hereby expressly reserved.

Approved, May 27, 1914.

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ANNUAL REPORT

OF THE

NATIONAL ACADEMY OF SCIENCES.

MEETINGS OF THE NATIONAL ACADEMY.

During the year 1920 the Academy held two stated meetings, the annual meeting in April, at Washington, and the autumn meeting in November, at Princeton, N. J.

ANNUAL MEETING.

The annual meeting of the Academy was held at the Smithsonian Institution in Washington, April 26, 27, and 28, 1920.

Eighty-eight members were present, as follows:

Abbot, C. G.
Bailey, L. H.
Bell, A. Graham
Boas, Franz
Bogert, M. T.
Bridgman, P. W.
Bumstead, H. A.
Campbell, W. W.
Carty, J. J.
Castle, W. E.
Cattell, J. McK.
Clarke, F. W.
Clarke, J. M.
Conklin, E. G.
Crew, Henry
Cross, Whitman
Curtis, H. D.
Dall, W. H.
Davenport, C. B.
Davis, W. M.
Day, A. L.
Dickson, L. E.
Donaldson, H. H.
Dunn, Gano
Durand, W. F.
Fewkes, J. W.
Forbes, S. A.
Frost, E. B.
Gomberg, Moses
Hale, George E.
Hall, E. H.
Hall, G. Stanley
Halsted, W. S.
Harper, R. A.
Harrison, R. G.
Henderson, L. J.
Hillebrand, W. F.
Holmes, W. H.
Howard, L. O.
Howe, H. M.
Howell, W. H.
Iddings, J. P.
Jennings, H. S.
Jewett, F. B.
Kasner, Edward
Langmuir, Irving
Leuschner, A. O.
Lewis, G. N.
Lindgren, Waldemar
Lusk, Graham
Lyman, Theodore
Meltzer, S. J.
Mendel, L. B.
Mendenhall, C. E.
Merriam, C. H.
Merriam, J. C.
Merritt, Ernest
Michelson, A. A.
Millikan, R. A.
Nichols, E. F.
Noyes, A. A.
Noyes, W. A.
Parker, G. H.
Pearl, Raymond
Ransome, F. L.
Reid, H. F.
Remsen, Ira
Rosa, E. B.
Russell, H. N.
Schlesinger, Frank
Setchell, W. A.
Smith, E. F.
Squier, G. O.
Stieglitz, Julius
Stratton, S. W.
Thomson, Elihu
Thorndike, E. L.
Trowbridge, Augustus
Veblen, Oswald
Walcott, C. D.
Webster, A. G.
Welch, W. H.
Wheeler, W. M.
White, David
White, H. S.
Wilson, E. B.
Wood, R. W.
Woodward, R. S

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BUSINESS SESSIONS.

The annual report of the president, containing that of the treasurer for 1919, in printed form, was presented, accepted, and distributed to the members.

The friends of the Academy contributing to the purchase of square 88, opposite the Lincoln Memorial in Potomac Park, for the National Academy of Sciences, referred to in the last annual report, were Edward Dean Adams, Charles F. Brush, George W. Crile, E. A. Deeds, Pierre S. Du Pont, George R. Eastman, Arthur H. Fleming, Henry Ford, Mrs. E. H. Harriman, H. E. Huntington, Thomas D. Jones, Charles F. Kettering, Adolph Lomb, Harold F. McCormick, A. W. Mellon, Raphael Pumpelly, Julius Rosenwald, John L. Severance, Ambrose Swasey, C. H. Swift, the trustees of the Commonwealth fund, and the Corning Glass Works.

Tellers to count preference ballots: E. B. Rosa (chairman), D. W. Taylor, and J. P. Iddings.

ASSIGNMENT OF BIOGRAPHIES.

Louis V. Pirsson, elected 1913, died December 8, 1919, assigned to J. P. Iddings.
Horatio C. Wood, elected 1879, died January 3, 1920.

CHANGES IN PERSONNEL OF SECTIONS AND COMMITTEES.

Sections.—J. J. Carty to succeed Gano Dunn as chairman of the engineering section, term expiring 1923. H. A. Bumstead to succeed E. F. Nichols as chairman of the section of physics, term expiring 1923.

Committees.—Henry Draper fund: H. N. Russell to succeed Joseph S. Ames, term expiring 1925.

J. Lawrence Smith fund: Whitman Cross to succeed E. W. Morley as chairman, term expiring 1922. Walter S. Adams to succeed E. W. Morley as member, term expiring 1924. Frank Schlesinger to succeed A. O. Leuschner, term expiring 1925.

Comstock fund: J. J. Carty to succeed Elihu Thomson, term expiring 1925.

Marsh fund: H. A. Bumstead to succeed E. S. Dana, term expiring 1923.

Murray fund: Alfred G. Mayor to succeed George H. Parker, term expiring 1923.

Marcellus Hartley fund: William H. Welch to succeed Theobald Smith, term expiring 1923. David W. Taylor to succeed Arthur G. Webster, term expiring 1923.

Mary Clark Thompson fund: Waldemar Lindgren to succeed Gano Dunn, term expiring 1923.

Local committee: C. G. Abbot, (chairman), Whitman Cross, L. O. Howard, C. E. Mendenhall, F. L. Ransome, Erwin F. Smith.

Delegates: To semicentennial of Wisconsin Academy of Sciences, Letters, and Arts, T. C. Chamberlin. To centennial of the Indiana University, J. M. Coulter.

REPORT OF THE TREASURER.

The report of the treasurer was presented in printed form and approved.

REPORT OF THE HOME SECRETARY.

The home secretary presented the following report, which was accepted:

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The PRESIDENT OF THE NATIONAL ACADEMY OF SCIENCES.

SIR: I have the honor to present the following report on the publications and membership of the National Academy of Sciences for the year ending April 26, 1920.

Two parts of volume 14 of the Memoirs of the National Academy of Sciences have been completed and distributed—the second memoir, Complete Classification of the Triad Systems on Fifteen Elements, by H. S. White, F. N. Cole, and L. D. Cummings, and the fourth memoir, Second Report on Researches on the Chemical and Mineralogical Composition of Meteorites, by G. P. Merrill.

The third memoir, Tables of the Minor Planets, by A. O. Leuschner, A. E. Glancy, and S. H. Levy, and the fifth and final memoir of volume 14, Tables of the Exponential Function and of the Sine and Circular Cosine to Radian Argument, by C. E. Van Orstrand, are now in page proof and will be issued shortly, as will also volume 15, Psychological Examining in the United States Army, by Robert M. Yerkes.

Volume 16, first memoir, Lower California and its Natural Resources, by E. W. Nelson, and the second memoir, Studies upon the Life Cycles of the Bacteria, by F. Löhnis, are now in galley proof. The third memoir, A Recalculation of Atomic Weights, by F. W. Clarke, is now in the hands of the printer.

Volume VIII of the Biographical Memoirs has been completed with the publication of the biographies of Benjamin Osgood Peirce and Cleveland Abbe, and the bound volume distributed. The following biographies forming a part of Volume IX have been completed and distributed: William Bullock Clark, by John M. Clarke; Arnold Hague, by Joseph P. Iddings; Eugene Waldemar Hilgard, by Frederic Slate; James Dwight Dana, by L. V. Pirsson; James Mason Crafts, by Charles R. Cross; Lewis Boss, by Benjamin Boss; and Alpheus Spring Packard, by T. D. A. Cockrell. That of Charles Sedgwick Minot is now in page proof.

Since the last meeting, two members have died. Louis V. Pirsson, elected 1913, died December 8, 1919, and Horatio C. Wood, elected in 1879, died January 3, 1920. This leaves an active membership of 175 members, 1 honorary member, and 31 foreign associates. One foreign associate is reported dead: Gustav Retzius, elected in 1909, died July 21, 1919.

C. G. ABBOT, *Home Secretary.*

RESEARCH FUNDS.

REPORT OF THE DIRECTORS OF THE BACHE FUND.

Since the annual meeting of the Academy in April, 1919, the following grants have been made:

214. C. H. Eigenmann, Indiana University, Bloomington, Ind., $1,000. For a continuation of the study of fresh-water fishes of South America.

215. H. W. Norris, Grinnell, Iowa, $100. For the study of the cranial nerves of the ganoid fishes.

216. Asa A. Schaeffer, University of Tennessee, Knoxville, Tenn., $450. For a continuation of investigations on the paths of blindfolded, etc., persons in endeavoring to walk straight ahead.

217. J. C. Jensen, Nebraska Wesleyan University, University Place, Nebr., $250. For an investigation on the electrical charge of falling rain.

218. H. Nort, Gouda, Holland, $200. For star counts on the Franklin-Adams charts.

219. Henry G. Barbour, Yale University, New Haven, Conn., $600. For study upon the regulation of bodily heat.

220. C. H. Eigenmann, Indiana University, $500 (supplemental to No. 214). To continue the study of fresh-water fishes of South America, of the eastern slope of the Andes of Peru and Ecuador.

221. William Bowie, United States Coast and Geodetic Survey, $150 (in conjunction with grants from the Draper and Gould funds). For temporary maintenance of the

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International Latitude Station at Ukiah, Calif., until a Government appropriation becomes available.

Reports of previous grants have been received as follows:

170. Edwin H. Hall, Harvard University. The money was expended mainly in payment for the services of assistants in a research the chief purpose of which was to determine, if possible, whether the Ettinghausen effect, a transverse temperature difference set up in a conductor carrying an electric current at right angles to the lines of a magnetic field, is established instantaneously to its full magnitude as soon as the conditions necessary to produce it are set up.

The research was inconclusive. Apparently the effect had reached its final value by the time it could be measured, but the measuring apparatus, a thermoelectric device, required a considerable part of a minute to arrive at the temperature of the point to which it was applied.

Incidentally some observations were made on the direction of the lines of flow of an electric current in a conductor subjected to a transverse magnetic field which is not everywhere uniform. These lines of flow are, of course, such as might have been expected, but they may be worth describing briefly.

Finally some measurements were made on the temperature coefficient of the Ettinghausen effect in iron.

208. A. F. Shull, Ann Arbor, Mich. Research included on "Cell inconstancy, in hydratina senta" and "Relative effectiveness of oxygen, food, and other substances in male-production." Former paper published in Journal of Morphology, March, 1918, later in Journal of Experimental Zoology, August, 1918.

Research is in progress on maturation and nuclear volume in rotifer, and progressive changes in cycle of aphids.

Work should have been completed some time ago, but was delayed by inability to secure additional stock of rotifers after loss sustained over a year ago.

209. Cecil K. Drinker, Harvard Medical School, Boston. Sections of injected specimens of bone marrow are still being made. These must be completed before final reports can be published.

210. Wayne J. Atwell, University of Buffalo, medical department. Preliminary results published in Anatomical Record for May, 1920, as a part of the proceedings of the American Association of Anatomists.

Research is in progress. Eleven wax-plate models showing development of the human hypophysis reconstructed; it is planned to make about four more reconstructions.

212. Arthur G. Webster, Clark University, Worcester, Mass. A paper will be read at the April, 1920, meeting of the Academy.

213. Duncan S. Johnson, Johns Hopkins University, Baltimore, Md. Cytological material of three liverworts was collected and carefully preserved in Jamaica last summer. This material is now being sectioned and studied in the laboratory to confirm and extend studies of living material made in Jamaica.

214. C. H. Eigenmann, Indiana University. Part of the material has been used to complete manuscript on The Fishes of Panama, Colombia, and the Pacific Slope of Ecuador and Peru. An outline of the expedition was published in Science and a chapter on the itinerary in Indiana University Alumni Quarterly. Work on the volumes on the fishes of Lake Titicaca and of Chile will be commenced shortly.

The amount available for grants on April 9, 1920, was $1,848.90. Grants 219, 220, and 221, total $1,250, have yet to be paid from this, and another appropriation ($500) has been favorably considered, so that the net amount immediately available would be about $100.

EDWIN B. FROST, *Chairman.*

Report received.

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REPORT OF THE COMMITTEE ON THE HENRY DRAPER FUND.

The committee recommended that the Henry Draper gold medal be awarded to Alfred Fowler, F. R. S., professor of astrophysics, Imperial College of Science and Technology, South Kensington, London, in recognition of his valuable contributions to our knowledge of sunspots, comets, and the extremely red stars, and for his interpretations of celestial phenomena by means of spectrographic observations in the laboratory. The committee's recommendation was confirmed at the meeting of the Academy in November, 1919. It is regretted that Prof. Fowler is unable to attend the present meeting of the Academy to receive the medal in person.

The committee has recommended that six grants from the Draper fund be made, as below. The first three grants were confirmed by the Academy in November, 1919; the last three are before the Academy for consideration.

1. Grant of $400 to Prof. S. A. Mitchell, director of the Leander McCormick Observatory, University of Virginia, to complete the purchase of a measuring microscope for use in the photographic determination of stellar parallaxes, on the basis of observations made with the 27-inch refracting telescope. The Academy awarded the sum of $250 from the Draper fund to Dr. Mitchell in 1916 to apply on the purchase of this instrument. The microscope cost $650. The proposed grant of $400 will complete the purchase, in effect making the instrument the property of the National Academy, and Prof. Mitchell will devote an equivalent sum, $400, to the other needs of his parallax research.

2. Grant of $300 to Dr. Joel Stebbins, professor of astronomy in the University of Illinois, to assist in the further development and application of the photoelectric cell photometer, with which to date he has accomplished notable results. The instrument which he has developed is, in our opinion, one of the most valuable additions to astronomical resources in the past two decades. It is the only instrument of the kind in American astromomy. A similar instrument has been used with great success in the Berlin-Babelsberg Observatory.

3. Grant of $400 to Dr. Frank Schlesinger, director of the Allegheny Observatory, to enable him to test an automatic zenith camera for the determination of terrestrial latitudes, with the expectation that the results will establish that this camera has important advantages. It is proposed that this instrument be mounted, at least temporarily, at the International Latitude Observatory at Ukiah, Calif., where the astronomer in charge, Dr. Neubauer, will operate it as a labor of love. The grant is needed to install the intrument at Ukiah and to make certain auxiliary apparatus required in its operation. The Allegheny Observatory is loaning the objective and the photographic plates obtained will be measured either by Director Schlesinger or under his supervision. It is confidently expected that studies of the latitude variation problem will contribute to our knowledge of the physics of the earth and therefore to astronomical physics.

4. Grant of $175 to Prof. E. B. Frost, director of the Yerkes Observatory, for the purchase of a Hess-Ives tint photometer for use in Yerkes Observatory to supplement the Hartmann microphotometer in the measurement of various illuminants, of the transmission of filters for various wave lengths, and of the absorption of photometric gratings and of other phenomena and subjects.

5. Grant of $500 to Dr. Antonio Abetti, director of the Arcetri Observatory, Florence, Italy, to apply on the cost of a combined spectograph and spectroheliograph for use in combination with a 60-foot tower telescope now under construction. It is planned that this instrument shall be used by the son of the director, Dr. Giorgio Abetti, well known to many American astronomers, recently transferred from the observatory in Rome to the Arcetri Observatory in Florence. Dr. Giorgio Abetti has had considerable experience with solar work in leading American solar observatories.

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6. Grant of $200 to Maj. William Bowie, Chief of the Division of Geodesy, United States Coast and Geodetic Survey, in temporary support of the International Latitude Observatory at Ukiah, Calif., to assist in meeting an emergency due to the failure of the observatory's regular source of funds. Unless assistance is received from the Draper and other funds the continuity of the work at Ukiah would be interrupted and this would be in the nature of a catastrophe. The relations of the latitude variation problem to astrophysics is suggested in outline in the last sentence of recommendation No. 3 above.

The bursar of the Academy reports that on March 21, 1920, the cash balance in the Draper fund available for the promotion of research was $1,065.04. The awarding of grants 4, 5, and 6, amounting to $875, would leave a cash balance of $190.04. Additional income, amount $917.50, is invested in a bond of the Milwaukee Railway & Electric Co., and its equivalent is likewise available for the promotion of research in astronomical physics. Total income available therefore is $1,107.54.

W. W. CAMPBELL, *Chairman.*

Report received and recommendations approved.

REPORT OF THE TRUSTEES OF THE WATSON FUND.

Grant No. 17. A grant of $500 was made in April, 1919, to Prof. John A. Miller, director of the Sproul Observatory of Swarthmore College, Pennsylvania, for the employment of an assistant in measuring and reducing plates for the determination of parallaxes. The grant has been used as part payment for the services of Miss Margaret E. Powell, who has given her entire attention to parallax work, including photographic exposures, measurement of the plates, and the reduction of the measurements. There are still many incompleted series, some of which require additional exposures, others completion and reduction of the measures.

Grant No. 18. A grant of $300 was made to Prof. Herbert C. Wilson, of Carleton College, Northfield, Minn., for the continuation of the photographic determination of the positions of minor planets. During the year 1919 the number of plates taken advanced from 439 to 505. On some of these the asteroids were not found, and a number were exposed to the pole for the purpose of determining magnitudes. The measurement of plates has gone on slowly, owing to the necessity of training new observers. The results of the measurements of 52 plates are now ready for publication, and 22 remain to be measured in order to bring the work up to January, 1920. Four plates of the asteroid discovered by Comas Sola in January, 1920, have been measured and reduced. Three more are yet to be measured. It is hoped that the results from all these plates may be published some time during the coming summer. Since the grant of last year has not been used up and will be sufficient to complete the measurement of plates thus far obtained, and pending the preparation of plans for international cooperation for the observations of minor planets on the part of the asteroid committee of the International Astronomical Union, no new grant is required for the immediate future.

Grant No. 19. A grant of $500 to Prof. J. A. Parkhurst for the employment of assistance in measuring and reducing plates for photographic and photovisual magnitudes in the north polar sequence and in the parallax field on which the Yerkes Observatory is working. The use of the fund began in June, 1919, the work being concentrated on the taking of plates, their measurement and reduction for photographic and photovisual magnitudes of all stars visible on the 40-inch plates in the 24 parallax fields at declination 45° in the "Kapteyn selected areas." Of the work in this project remaining at the beginning of the year, two-thirds is now completed and it is expected that by next August the results will be ready for publication.

More important than the magnitudes of these stars is the control which has been acquired over the methods of using the plates for photometric purposes. It is now possible to obtain the magnitudes and color indices of stars between the sixth and fifteenth magnitudes with a satisfactory degree of precision. The logical and desir-

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able continuation of the work would be its extension to other fields for which parallaxes have been and are being determined with the 40-inch telescope.

The trustees of the Watson fund submit the following recommendations:

Grant No. 20. That the appropriation of $500 to Prof. John A. Miller for the employment of assistance in measuring and reducing plates for the determination of parallaxes be renewed for the year beginning July 1, 1920.

Grant No. 21. That a further appropriation of $250 be made to Prof. J. A. Parkhurst for the employment of assistance in measuring and reducing plates for photographic and photovisual magnitudes in the north polar sequence and in the parallax field on which the Yerkes Observatory is working, the grant to be available during the year beginning July 1, 1920.

On March 31, 1920, there was a cash balance in the Watson fund amounting to $1,663.52. There is also available $1,000 of accrued income which is invested in bonds.

A. O. Leuschner, *Chairman.*
G. C. Comstock.
W. L. Elkins.

Report received and recommendations approved.

REPORT OF COMMITTEE ON THE J. LAWRENCE SMITH FUND.

No. 4. Prof. C. C. Trowbridge, of the department of physics, Columbia University, has received grants amounting to $1,400 in aid of his studies on meteor trains. After his death a paper on the spectra of luminous trains of meteor trains was completed from his notes and was transmitted to the academy. Since the annual meeting of 1919 other papers have been prepared, which describe all parts of the research which are sufficiently advanced for publication without further research. These are:

1. Auroras and magnetic disturbances. Posthumous paper of the late C. C. Trowbridge. Revised and edited by Mabel Weil.

2. Theories of the nature of meteor trains. A report on the researches of the late Prof. Trowbridge. By Mabel Weil.

3. An investigation on meteor trains. A report on the researches of the late Prof. Trowbridge. By Mabel Weil.

4. Auroral phenomena and the meteor train zone. A report on the researches of the late Prof. Trowbridge. By Mabel Weil.

The expense of the preparation of these papers has been met out of the small unexpended balance of the grant, which is now exhausted.

No. 7. Dr. George P. Merrill, head curator department of geology, United States National Museum, received in 1917 a grant of $400 to aid in further chemical study of certain meteorites. The results so far obtained have been published in the memoirs of the academy. There is an unexpended balance to Dr. Merrill's credit amounting to $230, which he hopes to be able to utilize soon.

No. 9. Prof. S. A. Mitchell, of the University of Virginia, has received grants amounting to $1,500 to aid in securing observations of meteor paths and radiants and in computing parabolic orbits when the observations suffice. This work has now been resumed, and the number of observations accumulated amounts to 22,000; a critical study of the results is in progress, which it is expected will give a good idea of the actual value of such researches. This material will soon be ready for the printer.

The committee recommend a further grant of $500 to Prof. S. A. Mitchell to aid in securing observations of meteor paths and discussing the results.

The J. Lawrence Smith fund now has a cash balance of income of $1,475.97 and a balance of invested income of $2,032.50.

For the committee.

Edward W. Morley, *Chairman.*

Report received and recommendation approved.

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REPORT OF THE DIRECTORS OF THE GOULD FUND.

The only appropriation from the Gould fund for the current year has been $600 to Benjamin Boss for the purpose of meeting part of the expenses of the Astronomical Journal.

Cash income balance on hand	$840.01
Invested income balance	6,250.00
Total income balance	7,090.01

F. R. MOULTON, *Chairman.*

Report received.

REPORT OF THE COMMITTEE ON THE MURRAY FUND.

The committee on the award of the Agassiz medal have the honor to report that their recommendation is that the medal be awarded to Admiral C. D. Sigsbee, United States Navy, retired, for his important contributions to oceanography, both by actual research, by publication of his results, and invention of new methods.

WM. H. DALL, *Chairman.*

Report received and recommendation approved.

REPORT OF THE COMMITTEE ON THE BARNARD MEDAL.

The committee recommends awarding the Barnard medal to Albert Einstein for highly original and fruitful development of the fundamental concepts of physics through application of mathematics.

A. A. NOYES, *Chairman.*

Report received.

REPORT OF THE DIRECTORS OF THE WOLCOTT GIBBS FUND.

The directors of the Wolcott Gibbs fund for chemical research respectfully present the following report to the National Academy of Sciences.

During the past year two applications for grants from the fund were received but too late to be acknowledged before the close of the year.

Holders of grants have reported as follows:

Grants 4 and 7. Prof. W. D. Harkins, of the University of Chicago, writes: "In choosing the most accurate data for the calculation of the ionization of salt solutions in water Prof. G. N. Lewis and G. A. Linhart chose eight of the salts determined by us, and only five other salts were considered as having accurate data."

These eight determinations were made with the potentiometer bought with grant 4.

The purchase of two air pumps and a quartz vacuum tube has used all but $38.10 of grant 7.

These pieces of apparatus have been used in continuing the study of cobalt amines with Dr. G. L. Clark, and on two researches suggested by the National Research Council and the Chemical Warfare Service. In one it was found that different volumes of different liquids penetrate gas-mask charcoal, and that the compressibility of the liquid is the most important factor in determining the penetration. A notice of this work has been printed in the proceedings of the Academy.

The other was a study of the absorption of certain vapors at very low pressures by the charcoal. This work is still in progress.

Grant 6. Prof. G. P. Baxter, of Harvard University, reports that papers are ready for the press describing his work on (1) electrotype deposition in a mercury cathode and the atomic weight of cadmium; (2) impurities of silver and iodine. Work on the analysis of arsenic trioxide and on the analysis of mercuric chloride was broken off by the war, but has now been resumed.

Grant 8. Prof. R. L. Datta, of Presidency College, Calcutta. No report has been received as yet from Prof. Datta.

The unexpended income of the fund is at present $965.56, of which the sum of $500 is temporarily invested in Liberty bonds.

C. L. JACKSON, *Chairman.*
EDGAR F. SMITH.
T. W. RICHARDS.

Report received.

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REPORT OF THE COMMITTEE ON THE MARSH FUND.

In accordance with a plan defined some years ago the committee on the Marsh fund has deemed it desirable to defer regular grants from this fund until such time as the accumulation of interest would bring the amount available up to $20,000. The committee is now informed that the sum at its disposal has reached a total of $20,000 with additional interest available to the amount of $764.57. The committee desires now to formulate as definitely as possible the principles according to which the distribution of income from the fund may be made in annual grants for the support of significant research.

After careful consideration of the purposes for which the fund was established the committee recommends that the following principles govern its action:

1. That the grants from the Marsh fund be used for the support of original researches rather than for the maintenance of publication.

2. That in general the income be used for the support of important pieces of constructive scholarly work within the field of science to which Prof. O. C. Marsh, the donor, gave his principal effort. It seems appropriate that grants should in the first instance be used for support of palaeontologic and geologic research, and that beyond that field the committee should next consider research in aspects of biology related especially to palaeontology.

J. C. MERRIAM, *Chairman.*

Report received and recommendations approved.

REPORT OF THE COMMITTEE ON THE DANIEL GIRAUD ELLIOT FUND.

Two medals have been awarded as follows:

For the year 1917: To Frank M. Chapman for his memoir on The Distribution of Bird Life in Columbia.

For the year 1918: To C. William Beebe for his memoir on The Pheasants.

The committee is requesting recommendations for the award for the year 1919, the award to be made to the best zoological work of the year.

The treasurer reports that on March 31, 1920, there was a cash balance of $564.81 in this fund, and that on the same date the sum of $300 of income was invested in Liberty bonds.

HENRY FAIRFIELD OSBORN, *Chairman.*

Report received.

RECOMMENDATIONS FROM THE COUNCIL.

The following recommendations from the council were adopted:

That the annual dues for 1920 be $5.

That the American Security & Trust Co., of Washington, D. C., and Spencer, Trask & Co., of New York, be designated fiscal advisers of the Academy for the year 1920–21.

That the time and place of the autumn meeting, 1920, be referred to the president and the home secretary with power.

That the official year of the National Academy of Sciences be changed from the calendar year (Jan. 1 to Dec. 31) to the fiscal year adopted by the United States Government (July 1 to June 30) and the amendment of the constitution and rules to carry this into effect be recommended.

AMENDMENTS TO CONSTITUTION.

The committee of the whole presented the following amendments to the constitution for consideration at the autumn meeting:

Article V, section 3, last paragraph:

The treasurer shall prepare a full report of the financial affairs of the Academy at the end of the fiscal year. This report shall be submitted to the council for approval

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and afterwards presented to the Academy at the *next* ~~annual~~ *stated* meeting. *He shall also prepare a supplementary financial statement to December 31 of the ensuing fiscal year for presentation at the annual meeting.*

Article III, section 2:

The names of the members present at each session of a meeting shall be recorded in the minutes and ~~the~~ *twenty* members ~~present at any session~~ shall constitute a quorum for the transaction of business.

AMENDMENT TO RULES.

The following new rules were adopted:

RULE II.

SEC. 3. The assistant secretary, who may be a nonmember of the Academy, shall receive a salary to be fixed by the council.

RULE III.

SEC. 6. No paper requiring more than 15 minutes for its presentation shall be accepted unless by invitation of the committee of arrangements.

No speaker shall occupy more than 30 minutes for presentation of papers during the scientific sessions of a single meeting of the Academy, except by invitation of the committee of arrangements.

Time shall not be extended except by vote of the Academy, and then not to exceed five minutes. The presiding officer shall warn speakers two minutes before the expiration of their time.

The discussion of individual papers shall be limited not to exceed five minutes and the total time for discussion by any one speaker for all scientific sessions in any one meeting shall not exceed 15 minutes unless approved by the Academy.

No paper shall be entered upon the printed program of scientific sessions unless the title is in the hands of the committee of arrangements at least two weeks in advance of the meeting. In the event that titles are received later, they shall be placed in order of receipt at the end of the list and read, if there is time. Such supplementary titles shall be conspicuously posted.

CONSERVATION OF NATURAL RESOURCES.

The following resolution on conservation of natural resources was referred to the council with power to act:

In the judgment of the Academy it is its proper function to indorse a well-organized movement for the conservation of the natural resources of the Republic and, subject to such organization being made effective through the American Association for the Advancement of Science, to recommend its support to the National Research Council.

JOHN C. MERRIAM.
JOHN M. CLARKE.

RESIGNATION.

The resignation of Mr. E. W. Morley as chairman and member of the committee on the J. Lawrence Smith fund was accepted with regret and a vote of appreciation was given to him by the Academy for past services in that capacity.

OPINION OF THE ATTORNEY GENERAL.

JANUARY 27, 1920.

SIR: You have referred to me, for opinion, a letter to you from Hon. Charles D. Walcott, president of the National Academy of Sciences, dated October 18, 1919, in which he asks the following questions:

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1. Is the National Research Council the authorized agent of the National Academy of Sciences?

2. Who is responsible for the contracts of the National Research Council?

3. Is additional documentary evidence necessary to complete the relation of the National Research Council to the National Academy of Sciences?

The National Academy of Sciences was incorporated by act of Congress approved March 3, 1863. Its charter constituted it a corporation and conferred upon it the power "to make its own organization, including its constitution, by-laws, and rules and regulations; to fill all vacancies created by death, resignation, or otherwise; to provide for the election of foreign and domestic members, the division into classes, and all other matters needful or usual to such institution, and to report the same to Congress." No limitation was placed upon the general powers thus granted. It was an organization related to the Government in that by the charter it was provided "the Academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art, the actual expense of such investigations, examinations, experiments, and reports to be paid from appropriations which may be made for the purpose, but the Academy shall receive no compensation whatever for any services to the Government of the United States."

The number of members of such corporation was by its original charter limited to 50 ordinary members, but by an act of Congress approved July 14, 1870, the limitation was removed.

By an act of Congress dated June 20, 1884, amended and enlarged by a later act approved May 27, 1914, said National Academy was authorized and empowered to receive by devise or in any other manner property, real or personal, to hold the same absolutely or in trust, to invest, reinvest, and manage the same according to the provisions of its constitution, and to apply said property and its income to the objects of its creation and according to the instructions of any donors, Congress reserving the right at any time to limit the amount of real estate which might be held by said Academy, and the length of time for which it might be held.

For the purposes of this memorandum it is only necessary to state that a constitution and rules were adopted which have been from time to time amended, and which regulate the transactions of the association. No limitations upon its methods of carrying into effect the purposes of its incorporation appear therein. The corporation appears to be possessed of quite an amount of property embraced in different funds, some devoted to special purposes; others to the general uses of the Academy. The management of financial affairs is vested in the treasurer under the direction of the finance committee. The governing body of the Academy is designated as "council," composed of six members elected by the Academy, together with the officers, to wit, the president, vice president, the foreign secretary, the home secretary, and the treasurer. The constitution prescribes that no contract shall be binding upon the Academy which has not first been approved by the council.

The constitution provides for an annual report to be made to Congress, thus complying with the provision of the charter, and it appears that such reports have been made, including the report showing the creation, continuance, and operations of the National Research Council. (The council of the Academy will be hereinafter referred to as "Academy council.")

The constitution also provides that the president of the Academy may call in the aid upon committees of expert persons not members.

By resolution adopted April 16, and 19, 1916, respectively, the Academy council directed its president to inform the President of the United States that the Academy desired to place itself at the disposal of the Government for any service within its scope in the event of a break of diplomatic relations with any country, and directed its president to appoint a committee to carry out the resolutions should such service be required by the Government. It also authorized its president to appoint a com-

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mittee to wait on the President of the United States, to call his attention to said resolutions tendering the Academy's services.

On April 26, 1916, said president and committee had a conference with the President of the United States, at which said services were tendered and accepted by the President.

On June 16, 1916, at a meeting of the Academy council, a report was made of the conference above held with the President in which, among other things, it was reported that the President suggested the formation of a committee to undertake such work as the Academy might propose, and to take steps looking to the organization and coordination of the scientific workers of resources of the country for the purpose of avoiding unnecessary duplication of effort. The president reported to the council that he had appointed a committee, naming them, on the organization of scientific resources of the country for national service. The committee so appointed reported a plan for the formation of a National Research Council, to consist of five members of the Academy, to be appointed by its president, of the president or other representative of the American Association for the Advancement of Science, of the American Philosophical Society, and of the American Academy of Arts and Sciences, a representative from the American Society of Civil Engineers, American Society of Mechanical Engineers, American Institute of Mining Engineers, American Institute of Electrical Engineers, together with a representative from the Departments of War, Navy, research laboratories, Government Bureaus of Public Health Service and the Department of Agriculture, the general purpose of this council to be to encourage the investigation of natural phenomena; the application of scientific principles to the development of American industries in the employment of scientific methods, and strengthening the national defense and promoting the national welfare. To accomplish this purpose it was recommended that the Research Council adopt certain specific measures mentioned, to wit, the making of certain inventories, the preparation of certain reports, together with such other measures as may be deemed advisable. This report appears to have been adopted by the Academy council and an organization known as the National Research Council (hereinafter styled "Research Council"), composed as above stated, created. This body appears to have functioned during the war and to have received large amounts from Government appropriations and private sources for its support and maintenance.

The existence of the Research Council and its work was recognized by the President by an Executive order dated May 11, 1918. Its institution by the National Academy of Sciences under its congressional charter was therein recognized, which was requested to perpetuate the National Research Council for the doing of certain duties specified in the said Executive order. It was also therein recognized that the effective prosecution of the Research Council's work required the cordial cooperation of the scientific and technical branches of the Government, civil and military, and that to this end the President of the United States would designate representatives of the Government upon the nomination of the president of the National Academy of Sciences, to serve as members of the council as heretofore, and that the heads of the departments immediately concerned were directed to cooperate in every way that may be required.

For the executive management of its affairs the Research Council has constituted an executive board and certain officers. The treasurer of the National Academy of Sciences is ex officio treasurer of the National Research Council.

Under article 5, regulating the nominations and appointments, all appointments to the National Research Council are either made by the president of the National Academy of Sciences or by the President of the United States upon the nomination of the president of the National Academy of Sciences, these being of Government officials.

All the proceedings of the National Research Council are reported to the National Academy of Sciences, and the report of its proceedings appears as a part of the annual report of said National Academy made to Congress. The existence of said National

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Research Council, its functions and its organization, have been quite fully reported to Congress, and its functions as an exercise of a part of the activities and powers of the National Academy have been recognized, at least by implication.

On February 11, 1919, a permanent constitution of the National Research Council was adopted, known as Organization of the National Research Council. The executive board of the Research Council recommended to the Academy council the adoption of this constitution, which was approved by the Academy council, and subsequently by the Academy in corporate meeting. This constitution states: "The National Academy of Sciences, under the authority conferred upon it by its charter enacted by Congress," etc., "adopts the following permanent organization for the National Research Council, to replace the temporary organization under which it has operated heretofore."

After setting forth its purposes, it further states: "The membership of the National Research Council shall be chosen with the view of rendering the council an effective federation of the principal research agencies in the United States concerned with the fields of science and technology named in" the article defining the purpose of the Research Council.

The National Research Council therefore occupies two relations to the National Academy: First, that of a special permanent agency for the carrying on of the scientific activities expressed in Article I of the above-mentioned plan of permanent organization; second, a federation under the National Academy of Sciences proper of the other scientific organizations of the country, engaged in practical scientific work, by incorporating the representatives from these bodies, as well as from the Government, into a standing committee appointed by the president of the National Academy of Sciences under its charter and general supervision.

It is evident from the above that the objects to be accomplished are such as are within the powers of the National Academy of Sciences. It is also plain that no other corporation is given any control over the National Academy or over the Research Council thus organized by it under its charter.

The Research Council has no control over the National Academy or its activities. The Academy can engage in all activities which the Research Council can exercise. While members of the council, other than the members of the National Academy, are selected from the representatives of the other scientific bodies, they are appointed by the president of the National Academy under the provisions of the plan of organization for the Research Council adopted by the National Academy. While certain Government officials are made members, the president of the National Academy, by its authority so given, selects them, and the President of the United States confirms his appointees. Every member of the Research Council is in this way selected by the authority of the National Academy under the authority and direction it has given in the "plan of organization" adopted by it.

Unless the Academy was therefore restricted by its charter in constituting an agency for scientific research and work to its own members, the National Research Council is an agency of that corporation.

In the absence of a charter restriction any persons may be chosen as directors or any other class of agents of a corporation. (State *v.* McDaniel, 22 Ohio St., 354; Wight *v.* Springfield, etc., R. R. Co., 117 Mass., 226; In re Election of St. Lawrence Steamboat Co., 44 N. J. L., 529.)

In this case this agency was duly constituted by the Academy council and the permanent organization by affirmative action of the Academy itself in corporate meeting "to replace the temporary organization under which it has operated heretofore."

As heretofore shown, the constitution permitted the calling in the aid of nonmembers of expert attainments upon committees.

A corporation can act only through agencies; and this agency, by this corporate action (as well as in other ways), has been constituted and its original organization recognized.

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In view of the wide powers of the National Academy, its right to constitute committees of various sorts, and its relation to the Government in the prosecution of scientific research and work in which the Government has an interest, the creation and constitution of the National Research Council, is a legitimate and proper exercise of the charter powers of the National Academy, and renders the same one of the agencies of the National Academy for the carrying out of the charter purposes with such powers as have been conferred by the National Academy of Sciences, as herein set forth in the several resolutions and acts of the Academy council in relation to its several organizations, and especially in the adoption of a constitution for the permanent organization of the National Research Council in corporate meeting.

The National Research Council has recognized its relation as an agency subject to the Academy council. As an instance, said Research Council sought the approval of the National Academy of its participation in the International Research Council, which would have been quite unnecessary if the bodies had been independent. The adoption by the annual meetings of the National Academy of reports made would also carry a ratification by the corporation of the action of the Academy council in its dealings with the National Research Council as one of the scientific organizations and agencies of the National Academy of Sciences.

I therefore am of the opinion that the National Research Council constitutes an agency of the National Academy of Sciences for the purposes and with the powers expressed in the paper entitled "Organization of the National Research Council," adopted February 11, 1919.

Replying to the question, "Who is responsible for the contracts of the National Research Council?" I do not find where the National Research Council, as an agency of the National Academy of Sciences, has been given any general authority to enter into contracts. The constitution of said Academy provides that no contract shall be binding upon the Academy which has not first been approved by the Academy council, and, therefore, viewing the Research Council as an agency of the Academy, possessing only the powers delegated to it, authority would be needed in order for it to make a contract binding upon the Academy; and where the executive board of such Research Council proposes to enter into such obligation it should obtain such authority. Where, however, the Academy council should authorize the Research Council to do certain things requiring the incurring of an expense, this would be a conference of authority for the incurring of such expense, just as if such direction had been given to any other agent chosen to do a particular thing.

I think, however, that except, perhaps, in dealing with funds which may have been specifically given to the National Research Council, and have been directed to be handled otherwise, and which therefore may be considered as a special trust or trusts to be administered as directed in the appropriation thereof, or by the donor, all contracts or expenditures for the National Research Council should be authorized and incurred as expenses of the National Academy, and should not be incurred by the Research Council as such, and that such incurring should be with the authority and in the name of the Academy; the Research Council occupying the position of a permanent standing committee raised by the Academy to conduct the work committed to it as work of the National Academy being accomplished through this agency.

Replying the the query, "Is additional documentary evidence necessary to complete the relation of the National Research Council to the National Academy of Sciences?" I suggest that, while it may not be necessary, it is certainly very desirable that there should be a further defining of the financial relations between these bodies so as to prevent any misapprehension or conflict from arising.

Respectfully,

C. B. AMES,
Acting Attorney General.

To the PRESIDENT.

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ELECTIONS.

At the annual elections, Messrs. Arthur L. Day and T. H. Morgan were elected members of the council.

The following new members were elected:

James Rowland Angell, University of Chicago, Chicago, Ill.

Henry Prentiss Armsby, State College, Pa.

Wilder Dwight Bancroft, Cornell University, Ithaca, N. Y.

Hans Frederick Blichfeldt, Stanford University, Calif.

Anton Julius Carlson, University of Chicago.

William Duane, Harvard University, Cambridge, Mass.

Lewis Ralph Jones, University of Wisconsin, Madison, Wis.

Elmer Peter Kohler, Harvard University, Cambridge, Mass.

Charles Kenneth Leith, University of Wisconsin, Madison, Wis.

Clarence Edwin McClung, University of Pennsylvania, Philadelphia, Pa.

Elmer Verner McCollum, John Hopkins University, Baltimore, Md.

George Washington Pierce, Harvard University, Cambridge, Mass.

Harris Joseph Ryan, Stanford University, Calif.

Joel Stebbins, Lick Observatory, Calif.

Bailey Willis, Stanford University, Calif.

The following foreign associates were elected:

Frank Dawson Adams, McGill University, Montreal, Canada.

Marie Ennemond Camille Jordan, College of France, Paris, France.

François Antoine Alfred Lacroix, Musée d'Histoire Naturelle, Paris, France.

Heike Kamerlingh Onnes, University of Leyden, Netherlands.

Sir David Prain, Royal Botanic Gardens, Kew, Surrey, England.

Santiago Ramon y Cajal, University of Madrid, Spain.

The home secretary was requested to transmit the thanks of the Academy to the Smithsonian Institution and to the Cosmos Club for the courtesies extended to the members of the Academy during the meeting.

SCIENTIFIC SESSIONS.

MEETINGS OF APRIL 26, 27, 1920.

MONDAY, APRIL 26.

SCIENTIFIC PAPERS.

John M. Clarke: Conservation of natural resources as a proper function of the National Academy.

Raymond Pearl: On the rate of growth of the population of the United States since 1790 and its mathematical expression. (Illustrated.)

Franz Boas: Growth and development as determined by environmental influences.

Charles B. Davenport: Plural births in man. (Illustrated.)

Samuel J. Meltzer: The importance of the presence of both sympathetic superior cervical ganglia to the maintenance of life; and their possible relations to respiratory diseases.

Charles D. Walcott: Structure of Marrella and allied Middle Cambrian crustaceans.

James R. Angell: The National Research Council. (Illustrated.)

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Robert M. Yerkes (introduced by E. L. Thorndike): A psychological study of the medical officers in the Army.

Robert W. Wood: Spectroscopic phenomena of very long vacuum tubes. (Illustrated.)

L. T. E. Thompson, C. N. Hickman, and N. Riffolt (introduced by Arthur G. Webster): The measurement of small time intervals and some applications, principally ballistic.

Robert A. Millikan: The effect of molecular structure upon the reflection of molecules from the surface of liquids and solids. (Illustrated.)

Arthur G. Webster: The Springfield rifle and the Leduc formulæ.

Arthur G. Webster: Some new methods in internal ballistics of the Springfield rifle.

George E. Hale: The 100-inch Hooker telescope of the Mount Wilson Observatory. (Illustrated.)

A. A. Michelson: The vertical interferometer. Preliminary tests in an attempt to measure the diameter of the stars. A modification of the Foucault method adapted to long-distance measurement of the velocity of light. (Illustrated.)

Arthur G. Webster: Preliminary measurements on the pressures in the "Onde de Choc."

Arthur G. Webster: On the connection of the specific heats with the equation of state of a gas.

Edwin H. Hall: Thermal conductivity of metals.

William Ellery Hale Lectures. Discussion: The Scale of the Universe. By Harlow Shapley, Mount Wilson Solar Observatory, and Heber D. Curtis, Lick Observatory. (Illustrated.)

TUESDAY, APRIL 27.

C. Hart Merriam: Distribution and villages of the Indian tribes of the Klamath River region, California. (Illustrated.)

John C. Merriam: Significance of correlation in function between the dentition and skeleton of the Sabre-tooth tiger. (Illustrated.)

George H. Parker: On the colonial nervous system of Renilla. (Illustrated.)

Douglas H. Campbell: The genus Botrychium and its relationships.

Frederick V. Coville: The influence of cold in stimulating the growth of plants. (Illustrated.)

Thomas B. Osborne and Lafayette B. Mendel: Some common foods as sources of vitamines.

Lawrence J. Henderson: The physico-chemical properties of hæmoglobin.

William A. Noyes and George H. Coleman: The direct combination of nitrogen and chlorine.

Gilbert N. Lewis: Valance and chemical affinity. (Illustrated.)

William F. Durand: Shock or water ram in pipe lines with imperfect reflection at the discharge end and including the effects of friction and nonuniform change of valve opening.

Leonard E. Dickson: Recent notable progress in the theory of numbers.

Edward Kasner: Geodesics and relativity.

F. E. Pernot (introduced by G. O. Squier): The use of alternating currents for submarine cable transmission. (Illustrated.)

George O. Squier: Multiplex telephony and telegraphy over open-circuit bare wires laid in the earth or sea. (Illustrated.)

Lyman J. Briggs: The air resistance of spheres. (Illustrated.)

Robert H. Goddard: The possibilities of the rocket in weather forecasting. (Illustrated.)

H. Fielding Reid: The distribution of land and water on the earth. (Illustrated.)

Waldemar Lindgren: The alterations of limestones in contact-metamorphism. (Illustrated.)

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Henry Norris Russell: Notes on the internal constitution of the stars.

Charles Greeley Abbot: New observations on the variability of the sun. (Illustrated.)

Irving Langmuir: The "quantel" theory: A new theory of the ether, matter, and electromagnetism.

Raymond Pearl: On a single numerical index of the age distribution of a population (by title).

Edward S. Dana: Biographical memoir of George Jarvis Brush (by title).

Mabel Weil: Reports on the researches of the late Prof. C. C. Trowbridge. (*a*) Auroras and magnetic disturbances. (*b*) Auroral phenomena and the meteor train zone. (*c*) An investigation of meteor trains. (*d*) Theories on the nature of meteor trains (by title).

Theodore Holm: The vegetation of the Alpine region of the Rocky Mountains in Colorado (by title).

S. W. Williston: Osteology of the reptiles (by title).

PRESENTATION OF MEDALS.

At the annual dinner of the Academy held on the evening of April 27, the Henry Draper gold medal was presented to the British ambassador, the Right Hon. Sir Auckland Geddes, K. C. B., for transmittal to Alfred Fowler, F. R. S., professor of astrophysics, Imperial College of Science and Technology, South Kensington. The award to Prof. Fowler was made for his valuable contributions to our knowledge of the solar corona, sunspots, comets, and the stars—especially the red stars of Secchi's Type III—on the basis of spectrographic observations. The medal for eminence in the appli- to the public welfare was presented to Herbert Hoover for his application of science in the conservation, selection, and distribution of food.

AUTUMN MEETING.

The autumn meeting of the Academy was held at Princeton University, Princeton, N. J., on November 15, 16, and 17, 1920.

In the absence of the president, Mr. Remsen was elected temporary chairman for the session of the Academy.

Forty-four members were in attendance, as follows:

Bridgman, P. W.
Bumstead, H. A.
Carty, J. J.
Cattell, J. McK.
Clarke, J. M.
Conklin, E. G.
Councilman, W. T.
Cross, Whitman
Davenport, C. B.
Davis, W. M.
Day, Arthur L.
Donaldson, H. H.
Duane, William
Flexner, Simon
Hall, Edwin H.
Harper, R. A.
Harrison, Ross G.
Howard, L. O.
Jennings, H. S.
Leuschner, Armin O.
Lindgren, Waldemar
Lyman, Theodore
Merriam, J. C.
Millikan, R. A.
Nichols, E. F.
Noyes, A. A.
Osborn, H. F.
Pearl, Raymond
Reid, H. F.
Remsen, Ira
Russell, H. N.
McCollum, E. V.
McClung, C. E.
Scott, W. B.
Smith, Theobald
Taylor, D. W.
Trowbridge, A.
Veblen, Oswald
Webster, Arthur G.
Welch, William H.
Wheeler, W. M.
Willis, Bailey
Wilson, E. B.
Wood, R. W.

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BUSINESS SESSIONS.

The following assignments of the biographies of deceased members were announced:

To Whitman Cross, the biographies of L. V. Pirsson, died December 8, 1919, and J. P. Iddings, died September 8, 1920.

To Ira Remsen, the biography of H. N. Morse, died September 8, 1920.

To W. H. Howell, the biography of S. J. Meltzer, died November 8, 1920.

Changes in personnel of committees:

Committee to audit accounts of the treasurer: L. O. Howard, A. Trowbridge, H. A. Bumstead.

Committee on conservation of natural resources: J. C. Merriam, J. M. Clarke, J. McK. Cattell.

Local committee: E. G. Conklin, A. G. Mayor, H. N. Russell, W. B. Scott, Theobald Smith, A. Trowbridge, Oswald Veblen.

The following selection of new members of the board of editors of the Proceedings was presented from the council:

Retiring: E. B. Frost, Jacques Loeb, E. H. Moore, E. L. Thorndike, W. M. Wheeler.

Incoming: William Duane, Ross G. Harrison, E. H. Moore, Frank Schlesinger, W. M. Wheeler.

Delegate to the London conference to discuss the financing of the International Catalogue of Scientific Literature and to the meeting at Strasbourg of the International Mathematical Union, L. E. Dickson.

AMENDMENTS TO CONSTITUTION.

The following amendments to the constitution from the committee of the whole at the business session of April 28, 1920, were adopted:

Article V, section 3, last paragraph:

The treasurer shall prepare a full report of the financial affairs of the Academy at the end of the fiscal year. This report shall be submitted to the council for approval and afterwards presented to the Academy at the ~~annual~~ *next stated* meeting. *He shall also prepare a supplementary financial statement to December 31 of the ensuing fiscal year for presentation at the annual meeting.*

Article III, section 2:

The names of the members present at each session of a meeting shall be recorded in the minutes and ~~the~~ *twenty* members ~~present at any session~~ shall constitute a quorum for the transaction of business.

AMENDMENTS TO RULES.

In order to carry the amendments to the constitution into effect the following amendments to the rules were adopted:

Amend paragraph 5 of Article V by changing in the first line the word "January" to "July," and in the first and second lines "January 15" to "August 1," and strike out in the second line, after the word "audited," the word "by," and insert in place thereof the words "under the direction of." In the third line strike out the word "autumn" and insert the word "annual," so that the first three lines of paragraph 5 shall read:

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"5. The accounts of the treasurer shall, between July 1 and August 1 of each year, be audited under the direction of a committee of three members to be appointed by the president at the annual meeting of the Academy."

In line 9 of paragraph 5, Article V, after the word "Academy," insert the words "including the National Research Council."

Strike out the last four lines of paragraph 5, Article V, and insert the following in place thereof: "The reports of the treasurer and auditing committee shall be presented to the Academy at the autumn meeting and shall be published with that of the president to Congress. They shall be distributed to the members in printed form at the annual meeting."

In line 1 of paragraph 4, Article VI, strike out the words "December 31" and insert in lieu thereof "June 30."

In paragraph 5 of Article VI, in the third line, before the word "members," strike out the word "two" and insert the word "five"; and after the word "president" add the following: "two of whom may be nonmembers of the Academy."

W. LINDGREN.
F. L. RANSOME.
C. D. WALCOTT.

The change in the fiscal year of the Academy from the calendar year to the fiscal year of the United States Government to commence with the report for the year 1921.

INTERNATIONAL RESEARCH COUNCIL.

Through the liberality of the trustees of the William Ellery Hale fund, the National Academy of Sciences was able to make a contribution of £100 toward the expenses of the International Research Council.

The following recommendation from the council was approved:

That the medal of the Academy for eminence in the application of science to the public welfare be awarded at the annual meeting of the Academy in April, 1921, to Charles Wardell Stiles, in consideration of his pioneer work in the recognition and eradication of the hookworm disease.

SCIENCE NEWS SERVICE.

Mr. Noyes presented the following report prepared by Mr. W. E. Ritter on the Science News Service:

The Science News Service, now in process of development, is the outgrowth of a meeting held on November 11, 1919, at Miramar, Calif., the home of Mr. E. W. Scripps, at which Mr. E. W. Scripps, Mr. Robert P. Scripps, and Mr. W. E. Ritter were present.

The object of the organization was stated as follows:

"To make the greatest possible use of the press in the way of disseminating that knowledge which is the result of painstaking research carried on by well-trained scientists."

For this purpose the founder, Mr. E. W. Scripps, placed at the disposal of the organization the sum of $30,000 a year for two formative years, agreeing that if the scheme were entirely successful to endow the service with $500,000.

It was the intention of the founder that the enterprise should be conducted on a self-supporting basis, though not for profit to any person or group of persons, but that fair compensation should be rendered to the editors, business manager, and writers—those upon whom would chiefly devolve responsibility for making the organization an instrument of great public service.

On invitation addressed severally to the presidents of the National Academy of Sciences and the American Association for the Advancement of Science and the

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chairman of the National Research Council, the following were appointed as representatives of the above-named organizations: George E. Hale, representing the National Academy of Sciences; D. T. McDougal, representing the American Association for the Advancement of Science; and R. A. Millikan, representing the National Research Council. Dr. Millikan later resigned and A. A. Noyes was appointed in his place.

These, together with the initial membership of three, met at Miramar on March 18, 1920. At this meeting "Science News Service" was adopted as the name of the organization, and it was voted "that the Science News Service be an independent corporation which shall be affiliated, in ways which shall be hereinafter specified, with the National Academy of Sciences, the American Association for the Advancement of Science, and the National Research Council."

The latest meeting of the corporation was held at Miramar on July 7, 1920, and it was voted at that time "That the Science News Service invite the National Academy of Sciences, the American Association for the Advancement of Science, and the National Research Council, each severally, to nominate for membership in the Science News Service, in addition to the representatives already nominated by the said bodies, namely, George E. Hale, D. T. McDougal, and A. A. Noyes, two members to serve for terms of two and four years, respectively."

In accordance with this action the National Academy of Sciences is herewith informed of the steps so far taken toward the formation of the Science News Service, and is requested to nominate its additional representatives at as early a date as possible.

When the nominations of the three societies are made a meeting of the Science News Service will be called, action on the nominations will be taken, and the organization then can soon be made ready for work.

WM. E. RITTER.

LA JOLLA, CALIF., *July 21, 1920.*

The Academy authorized the appointment by the council of three representatives to serve on the board of the Science News Service. The council was also instructed to convey to Mr. E. W. Scripps the appreciation of the Academy for his liberality and foresight in this gift to science.

REPORT OF THE COMMITTEE ON CONSERVATION OF NATURAL RESOURCES.

Your committee has been profoundly impressed by the supreme importance, usefulness, and magnitude of the general movement on conservation of the natural resources of the Republic, and it tentatively reports that the matter outlines itself as follows:

To be made effective, such a movement must be dignified and substantially supported, and the effort must be sustained. It must be primarily and essentially educative, and this educative promulgation should avail itself of all official and administrative educational agencies of the States and the Nation. The appeal to and through these agencies should be based upon patriotism and the true piety which expresses itself in the sentiment of unselfishness and the purpose to perpetuate our national heritage. It should have a background of formal and impressive support by a body of high-minded and influential citizens of the Republic, and it will require the activity of a competent central committee.

In the present opinion of your committee, there is every reason why the work should begin at once by careful compilation (at modest cost under the auspices of the National Research Council) of a list of all active conservation agencies of whatever character, with the purpose of eventually coordinating these organized activities and uniting them in support of the general movement.

J. C. MERRIAM, *Chairman.*

Report received and approved.

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REPORT OF THE COMMITTEE ON THE MARY CLARK THOMPSON MEDAL.

After long correspondence with the best of French medalists and various experiments in the rendering of a suitable design, the work of executing the medal in correct medallic form was assigned to Theodore Spicer-Simson, of New York, and his work has now been completed and a proof struck. In this form the medal has been submitted to the council and approved by them.

The cost of the designs and execution has been larger than anticipated on account of prevailing financial conditions, and by agreement the designer is to wait for the balance due upon payments to him for this work. This condition will make it necessary to defer for the present the award of this medal unless such award is provided for otherwise than through the income from the Thompson fund.

JOHN M. CLARKE, *Chairman.*

Report received and recommendations approved.

TRUSTEES OF THE WATSON FUND.

The following recommendation from the trustees of the Watson fund was approved:

That a grant of $300 be made to aid Herbert C. Wilson, of Northfield, Minn., in work on the Watson asteroids.

THEODORE N. VAIL.

The following resolutions from the National Research Council on the death of Theodore N. Vail were presented from the council and the Academy directed that they be spread upon the minutes:

MAY 18, 1920.

Whereas the National Research Council in annual meeting assembled in Washington, April 25, 1920, learns with regret of the death of Theodore N. Vail, it is hereby unanimously

Resolved, That in the death of Theodore N. Vail, chairman of the advisory committee of the National Research Council, leader of men, organizer of industry, constructive thinker gifted with imagination, lover of science, the council, in common with all other organizations that have felt his dynamic personality, suffers an irreparable loss; the cause of science for itself and for the utility of its application to the industries of the United States is bereft of a great personality which saw the all but unlimited possibilities with which scientific research was pregnant for good to his fellow citizens and to the world, and strove to realize the advancement of human knowledge and the benefits to his country which an indefatigable support and fostering of research could richly confer; and be it further

Resolved, That a copy of this resolution be spread upon the minutes, be communicated to his bereaved relatives, to the National Academy of Sciences, and to the American Telephone & Telegraph Co., of which he was chairman.

The home secretary was requested to transmit the thanks of the Academy to the president and the board of trustees of Princeton University, to the department of animal pathology of the Rockefeller Institute, to the members of the Nassau Club, and members of the Academy resident in Princeton serving as a local committee, for the courtesies extended to the members of the National Academy of Sciences at its autumn meeting, November 15, 16, and 17, 1920.

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SCIENTIFIC SESSIONS.

MEETINGS OF NOVEMBER 16 AND 17, 1920.

TUESDAY, NOVEMBER 16.

SCIENTIFIC PAPERS.

W. Duane: Some approximate computations of X-ray wave lengths.

E. H. Hall: The Peltier effect.

R. A. Millikan: New facts bearing on the structure of the helium atom.

The measurement of the ionizing potential of metallic surfaces.

Further progress in the extreme ultra-violet.

R. W. Wood: Fluorescence and chemical change in very intense light fields.

A. Trowbridge: A high-speed photographic recording galvanometer for laboratory or technical use.

Explosions of mixtures of coal gas and air under constant-volume conditions.

L. O. Howard: A postwar use of war material.

N. L. Britton: The investigation of the flora of northern South America by the United States National Museum, the Gray Herbarium of Harvard University, and the New York Botanical Garden.

U. Dahlgren (introduced by E. G. Conklin): The segregation and control of the light-producing substances in organisms (by title).

A. G. Mayor: Rose Atoll, Samoa (by title).

W. N. Benson (introduced by Arthur L. Day): The tectonic conditions accompanying the intrusion of basic and ultrabasic igneous rocks (by title).

John M. Clarke. The oldest forest. Lantern.

H. F. Osborn: The evolution of the proboscidea. Lantern.

Baron Gerhard DeGeer (introduced by H. F. Osborn): The struggle between sun and ice for the past 10,000 years. Lantern.

J. F. Kemp: Unusual features of sedimentation in the Pennsylvanian strata, Bingham Canyon, Utah.

W. Bowie (introduced by A. O. Leuschner): Some geologic conclusions from geodetic data.

W. B. Scott: Origin of the North and South American faunas (by title).

W. J. Sinclair (introduced by W. B. Scott): The red layer, a contribution to the stratigraphy of the White River oligocene (by title).

W. M. Davis: Lessons of the Grand Canyon. Lecture complimentary to the citizens of Princeton.

WEDNESDAY, NOVEMBER 17.

W. M. Davis: Islands near the border of the Coral Seas.

E. B. Wilson: Equipartition of energy.

E. Kasner: Einstein gravitational fields: Orbits and light rays.

H. N. Russell: Note on the Sobral eclipse photographs (by title).

J. W. Alexander (introduced by Oswald Veblen): Knots and Riemann spaces (by title).

Philip Franklin (introduced by Oswald Veblen): The map-coloring problem (by title).

E. L. Nichols: Luminescence at high temperatures.

J. Kendall (introduced by M. T. Bogert): The molecular state of water vapor.

The correlation of solubility, compound formation, ionization, and electro affinity in solution.

E. P. Adams (introduced by H. N. Russell): The Corbino effect in iron (by title).

W. C. Menzies (introduced by Oswald Veblen): The application of a differential thermometer in ebullioscopy (by title).

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A. H. Philips (introduced by W. B. Scott): Occurrence of copper and zinc in marine animals and calcareous muds (by title).

Hugh S. Taylor (introduced by Oswald Veblen): The adsorption of gases by metallic catalysts (by title).

Donald P. Smith (introduced by Oswald Veblen): Experiments on electrical conduction in a hydrogen alloy (by title).

Theobald Smith: Biological aspects of the process of infection.

S. B. Wolbach (introduced by W. T. Councilman): Typhus fever, with description of the aetiology.

H. H. Donaldson: Changes in the ear of the rat on the inception of hearing.

R. G. Harrison: Experiments on the development of the gills in amphibians.

C. E. McClung: An important period in the process of synapsis.

W. W. Swingle (introduced by E. G. Conklin): The sexual cycle of the larval bullfrog. Lantern.

F. G. Benedict: The basal metabolism of girls 12 to 17 years of age (by title).

L. B. Mendel: Growth on diets poor in true fats.

F. Boas: The measurement of differences between races.

E. B. Davenport: Anthropology in the Army.

Raymond Pearl: Further data on population growth (by title).

John Auer (introduced by S. J. Meltzer): The duration of construction of blood vessels by epinephrin.

S. J. Meltzer: On a life-saving action of epinephrin, with a lantern-slide demonstration (by title).

Martha Wollstein (introduced by S. J. Meltzer): Nature of the effect of double vagotomy in rabbits.

BUSINESS OF THE COUNCIL.

PROCEEDINGS.

The following recommendations of the joint committee of the National Academy of Sciences and of the National Research Council upon publications were approved:

1. That the National Academy of Sciences and the National Research Council cooperate in the publication of the Proceedings, beginning with Volume VII.

2. That the material published in the Proceedings consist only of articles in brief form of permanent scientific value.

3. That the management of the Proceedings be vested in an executive committee of three, consisting of the managing editor as chairman, for a term of one year, of a representative of the Academy, and a representative of the National Research Council, each to be appointed for a term of three years.

4. That the editorial board consist of the home secretary and the foreign secretary of the Academy, the chairman and the permanent secretary of the National Research Council as ex-officio members, and in addition of 10 representatives of the Academy and seven representatives of the Research Council, these numbers corresponding to the number of sections of the Academy and the number of divisions of science and technology of the Research Council.

5. That, beginning with Volume VII, the financial responsibility of the Proceedings be shared equally by the National Academy and the Research Council.

6. That, beginning with Volume VII, the operation of the Proceedings be placed upon a budget basis the size of the volume in any year to be determined by the conditions of the budget, the equal amounts contributed by each organization being determined by mutual agreement before the beginning of each calendar year.

7. That the managing editor of the Proceedings be appointed by the council of the Academy and the executive board of the National Research Council upon the nomination of the editorial board.

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FIFTH ANNUAL REPORT OF THE NATIONAL RESEARCH COUNCIL.

[Prepared by VERNON KELLOGG, permanent secretary, and the chairmen of divisions.]

INTRODUCTION.

As explained in the fourth annual report of the council (for 1919), the reorganization of the council converting it from a war-time organization (with an admirable record of useful achievement) to a peace-time organization, was accomplished during the end of 1918 and beginning of 1919. In this period a skeleton of organization was clothed with the flesh of a living, active personnel, and a definite program of undertaking was laid out. This program has been looked on as a flexible and adaptable one, capable of expansion or reduction or other modification even to the extent, if it seemed desirable, of complete making over. As a matter of fact this program has so far been followed along its essential original lines, the principal changes made in it being ones of extension.

The history of the National Research Council during 1920 is that of an organization controlled by its own membership and supported by other than Government aid. However, as indicated in the fourth annual report, it is the policy and hope of the council to maintain close contact with Government departments and organizations interested in specific scientific work and in the general promotion of science in the United States. To this end the council maintains a special division of Federal relations (formerly called the Government division) which includes in its membership representatives, appointed by the President of the United States, of various Government scientific departments, bureaus, and organizations. This division, therefore, formally and actually provides definite contacts between the council and the Government.

GENERAL POLICIES AND ORGANIZATION.

There has been no essential change in the general policies or organization of the council. As it exists to-day, therefore, the National Research Council is a cooperative organization of the scientific men of America, including also a representation of men of affairs and business men interested in industry and engineering and in the fundamental or "pure" science on which the "applied" science used in these activities depends. The council enjoys the formal recognition and active cooperation of most of the major scientific and technical societies of the country, its membership being composed in large part of appointed representatives of these societies. Its essential purpose is the promotion of research in the

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physical and biological sciences and the encouragement of the application and dissemination of scientific knowledge for the benefit of the Nation.

The council is composed of a series of major divisions, one group of seven divisions of science and technology representing, respectively, physics, mathematics and astronomy; chemistry and chemical technology; psychology and anthropology; geology and geography; biology and agriculture; the medical sciences; and engineering; and another group of six divisions of general relations, representing foreign relations, Federal relations, States relations, educational relations, research extension, and research information. As subordinate or affiliated lesser groups, each of these divisions comprises a larger or smaller series of committees, each with its special problem or subject of attention. There are certain other committees, administrative and technical, which affiliate directly with the executive board of the council. Its general administrative officers are a chairman, three vice chairmen, permanent secretary, treasurer, and a chairman of each of the various divisions. All of these, except the permanent secretary and treasurer, are elected annually by the executive board or by the members of the divisions.

The council is neither a large operating scientific laboratory nor a repository of large funds to be given away to scattered scientific workers or institutions. It is rather an organization which while clearly recognizing the unique value of individual work, hopes especially to help bring together scattered work and workers and to assist n coordinating in some measure scientific attack in America on large problems in any and all lines of scientific activity, especially, perhaps, on those problems which depend for successful solution on the cooperation of several or many workers and laboratories, either within the realms of a single science or representing different realms in which various parts of a single problem may lie. It particularly intends not to duplicate or in the slightest degree to interfere with work already under way; to such work it only hopes to offer encouragement and support where needed and possible to be given. It hopes to help maintain the morale of devoted isolated investigators and to stimulate renewed effort among groups willing but halted by obstacles. It will try to encourage the interest of universities and colleges in research work and the training of research workers, so that the inspiration and fitting of American youth for scientific work may never fall so low as to threaten to interrupt the constantly needed output of well-trained and devoted scientific talent in the land.

With any serious interruption in the output of American science and scientific workers, the strength of the Nation will be immediately threatened. The industries are to-day seriously draining the universities and the technical bureaus of the Government in their eager

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search for scientific men. This may mean an immediate advantage to the industries, but it means also an immediate menace to the indispensable scientific work of the Government and universities. It is the obtaining of a supply of scientific men to satisfy the needs of the industries at the present at the expense of the provision of scientific men for the future. For it is upon the presence in the universities of a large body of devoted and inspiring scientific workers and teachers that the training and inspiration of new workers depends.

The methods of contributing practical assistance to American science in harmony with the general point of view and policy outlined above which the council has so far adopted are various. One is the establishment of special committees of carefully chosen experts for specific scientific subjects or problems urgently needing consideration, which plan modes of attack and undertake to find men and means (with the assistance of the general administrative offices of the council) for carrying out the plan. About 80 such committees are now in existence. Another is the bringing together of industrial concerns interested in the development of the scientific basis of their processes and inducing them to support the establishment of special laboratories or institutions devoted to this development under the advice of experts representing the council. Another is the stimulation of larger industrial organizations, which may be in the situation to maintain their own independent laboratories, to see the advantage of contributing to the support of pure science in the universities and research institutes for the sake of increasing scientific knowledge and scientific personnel on which future progress in applied science absolutely depends. Other methods are the direct maintenance of university research fellowships; the publication of valuable scientific papers for which there is at present no other suitable prompt means of issuance; the preparation of bibliographies and abstracts of current scientific literature; the setting up of well-considered mechanisms for the collection and distribution of information on current research, university and industrial research laboratories and facilities, research personnel, etc.; and the dissemination through the press and magazines of popular but authentic scientific news and information for the sake of increasing the public interest in and support of productive scientific work. Still other forms of activities might be listed, but those given adequately illustrate the council's methods.

RELATIONS TO THE NATIONAL ACADEMY OF SCIENCES.

The National Research Council was established in 1916 at the request of the President of the United States under the charter of the National Academy of Sciences. The existence of the council and its work was specially recognized by the President by an Executive order dated May 11, 1918, in which its institution by the Academy

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under its congressional charter was referred to, and the Academy was requested by this order to perpetuate the council for the doing of certain duties specified in the order. In an opinion rendered by the Attorney General of the United States on January 29, 1920, the National Research Council was recognized as a special agency of the National Academy of Sciences for the accomplishment of certain particular purposes.

The funds derived by gift or otherwise for the use of the council are held by the Academy and are paid out only on general or specific authorization of the Academy. The treasurer of the Academy is ex officio treasurer of the council and all checks made out by the bursar of the council are signed by an official of the Academy and one of the council. The council participates on equal terms with the Academy in the support and use of the Proceedings of the Academy.

But the council has its own officers and membership and determines, under the general provisions of its founding by the Academy, its own policies and activities.

RELATIONS TO THE ENGINEERING FOUNDATION.

The Engineering Foundation, established in 1914 by the United Engineering Society, representing the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers, cooperates closely with the division of engineering of the National Research Council. While the Engineering Foundation reserves the right to conduct researches under its own direction it is now supporting some of the research projects of the division of engineering, notably a research in the fatigue phenomena of metals, and in addition is paying part of the administrative expenses of the division. The offices of the division are in the Engineering Societies Building at 29 West Thirty-ninth Street, New York City.

FINANCIAL SUPPORT AND GIFTS.

The major support for the general maintenance expenses of the National Research Council during the past year has come from the Carnegie Corporation of New York. The corporation in March, 1919, expressed its readiness to appropriate $5,000,000 for the erection of a building for the joint use of the council and the National Academy of Sciences, and for an endowment for the council, provided a suitable site in Washington should be obtained from other sources and a satisfactory plan for the building should be presented. The site has been procured and the building plans are in course of preparation. In the meantime the corporation appropriated $170,000 to the council for current expenses for 1920.

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From the Rockefeller Foundation appropriations have been received for the support of the National Research fellowships in physics and chemistry as provided for in a pledge made by the foundation in April, 1919, to appropriate a total sum not to exceed $500,000 for the support of these fellowships in the period May 1, 1919, to June 30, 1925; also for the support of the necessary expenses in 1920 of the special committees of the division of physical sciences. The Rockefeller Foundation also appropriated in December, 1920, the sum of $15,000 to defray the expenses of the committees of the division of physical sciences in 1921.

From the General Education Board appropriations were received for the support of a special committee on the mental rating of school children and for the support of a survey of the research situation in the colleges and universities of the country undertaken by the division of educational relations. A first appropriation of $10,000 for this latter purpose was made in September, 1919, for carrying on the survey until September 30, 1920, and a second appropriation of the same amount was made in December, 1920, for continuing the survey until December, 1921.

The Commonwealth Fund made an appropriation of $2,000 a month for the six months of January to June, 1920, to help meet the current expenses of the council.

For the support of an investigation, under the direction of a special committee of the division of engineering, of fatigue phenomena of metals, the Engineering Foundation appropriated $15,000 for 1920 (with $15,000 more pledged for 1921) and General Electric Co. gave $30,000 to extend the research. The University of Illinois provided expert service and use of laboratories and equipment equivalent to $6,000.

An industrial organization has pledged itself to give the council $25,000 annually for five years for use in the promotion of fundamental research.

The Southern Pine Association appropriated $10,000 for the use of the committee on forestry of the division of biology in organizing and maintaining certain forestry researches.

E. I. du Pont de Nemours & Co. gave $5,000 and the General Motors Corporation $2,500 to the Council for the special use of the research information service.

The William Ellery Hale fund gave the council $5,000 for the use of the division of foreign relations in the payment of the share of the United States in the expenses of the International Research Council and Associated International Unions, and $750 for defraying the traveling expenses of delegates to the London conference on the International Catalogue of Scientific Literature.

Mr. Julius Rosenwald, of Chicago, gave the council $1,500 for the maintenance of a special fellowship in biology.

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Merrell-Soule Co. gave $2,000 and the Corn Products Refining Co. gave $1,000 for the special use of the food and nutrition committee of the division of biology and agriculture.

A friend gave the council $1,000 for defraying the expenses of a conference on industrial personnel research.

The Glass Containers' Association gave the council $1,000 for the use of a special committee of the division of biology and agriculture on food-products investigation.

The Corning Glass Works gave the council $800 for the support of a research fellowship in ceramics at the University of Illinois.

For the support of various special research projects now under way or planned, gifts or pledges from various sources have been made, the details of which are not yet ready for publication. The most notable of these are the gifts and the pledges of money or expert service for the support of the preparation and publication of critical tables of physical and chemical constants. These gifts and pledges now amount in money value to approximately $90,000. It is necessary to obtain at least $200,000 in money and expert service for this undertaking. (See special reference in the report of the division of research extension.)

NEW BUILDING.

In conformity with the provision made in connection with the appropriation by the Carnegie Corporation, of New York, for the erection of a building for the joint use of the National Academy of Sciences and the National Research Council, a desirable site in Washington has been obtained for approximately $185,000 by the generous gifts of the following donors to the National Academy of Sciences: Thomas D. Jones, Harold F. McCormick, Julius Rosenwald, and Charles H. Swift, Chicago; Charles F. Brush, George W. Crile, John L. Severance, and Ambrose Swasey, Cleveland; Edward Dean Adams, Mrs. E. H. Harriman, and the Commonwealth Fund, New York City; George Eastman and Adolph Lomb, Rochester; E. A. Deeds and Charles F. Kettering, Dayton; Henry Ford, Detroit; Arthur H. Fleming, Pasadena; A. W. Mellon, Pittsburgh; Pierre S. du Pont, Wilmington; Raphael Pumpelly, Newport; Mr. and Mrs. H. E. Huntington, Los Angeles; Corning Glass Works, Corning, N. Y.

This site is the entire block between Twenty-first and Twenty-second and B and C Streets, almost directly opposite the Lincoln Memorial.

The preparation of plans for the building is now under way, and the council and Academy are confident that the new building will be of great architectural interest and beauty and admirably fitted for practical use.

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PRESENT QUARTERS.

Because of the sale to the National Education Association of the building at 1201 Sixteenth Street, which was used by the council in 1919, new quarters had to be found. The council was fortunate in being able to lease a building providing suitable accommodations and in a desirable part of the city, at 1701 Massachusetts Avenue, into which it moved in June, 1920, and which it now holds on a two-year lease, from July 1, 1920, subject, however, to possible sale on 90 days notice.

PUBLICATIONS.

Following careful study of the council's needs and opportunities for service through publication, the Proceedings of the National Academy of Sciences was designated as the official organ of the National Research Council for the publication of minutes of meetings, accounts of research, committee, and other reports.

At the same time, the Bulletin of the National Research Council was established for the publication of contributions from the Research Council other than proceedings, for which hitherto no appropriate agencies of publication have existed, and the Reprint and Circular Series for the issuance and listing of miscellaneous materials, either printed or published, which are desired for circulation by the Research Council.

Ten numbers of the Bulletin, the titles of which are listed below, have either been issued or are in press. In the Reprint and Circular Series 14 numbers have been listed.

BULLETIN OF THE NATIONAL RESEARCH COUNCIL.

VOLUME 1.

No. 1. The national importance of scientific and industrial research. By George Ellery Hale and others. October, 1919. 43 pages.

No. 2. Research laboratories in industrial establishments of the United States of America. Compiled by Alfred D. Flinn. March, 1920. 85 pages.

No. 3. Periodical bibliographies and abstracts for the scientific and technological journals of the world. Compiled by R. Cobb. June, 1920. 24 pages.

No. 4. North American forest research. Compiled by the committee on American orest research, Society of American Foresters. August, 1920. 146 pages.

No. 5. The quantum theory. By Edwin P. Adams. October, 1920. 81 pages.

No. 6. Data relating to X-ray spectra. By William Duane. (In press.)

No. 7. Intensity of emission of X-rays and their reflection from crystals. By Bergen Davis. Problems of X-ray emission. By David L. Webster. (In press.)

No. 8. Intellectual and educational status of the medical profession as represented in the United States Army. By Margaret V. Cobb and Robert M. Yerkes. (In press.)

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VOLUME 2.

No. 9. Funds available in the United States of America for the support of scientific research. Compiled by Callie Hull. (In press.)

No. 10. Report on photo-electricity, including ionizing and radiating potentials and related effects. By Arthur Llewelyn Hughes. (In press.)

REPRINT AND CIRCULAR SERIES OF THE NATIONAL RESEARCH COUNCIL.

No. 1. Report of the patent committee of the National Research Council. Presented for the committee by L. H. Baekeland, acting chairman. February, 1919. 24 pages.

No. 2. Report of the psychology committee of the National Research Council. Presented for the committee by Robert M. Yerkes, chairman. March, 1919. 51 pages.

No. 3. Refractory materials as a field for research. By Edward W. Washburn. January, 1919. 24 pages.

No. 4. Industrial research. By F. B. Jewett. 1918. 16 pages.

No. 5. Some problems of sidereal astronomy. By Henry N. Russell. October, 1919. 26 pages.

No. 6. The development of research in the United States. By James Rowland Angell. November, 1919. 13 pages.

No. 7. The larger opportunities for research on the relations of solar and terrestrial radiation. By C. G. Abbot. February, 1920. 14 pages.

No. 8. Science and the industries. By John J. Carty. February, 1920. 16 pages.

No. 9. A reading list on scientific and industrial research and the service of the chemist to industry. By Clarence Jay West. April, 1920. 45 pages.

No. 10. Report on the organization of the International Astronomical Union. Presented for the American section, International Astronomical Union, by W. W. Campbell, chairman, and Joel Stebbins, secretary. June, 1920. 48 pages.

No. 11. A survey of research problems in geophysics. Prepared by chairmen of sections of the American Geophysical Union. (In press.)

No. 12. Doctorates conferred in the sciences in 1920 by American universities. Compiled by Callie Hull. (In press.)

No. 13. Research problems in colloid chemistry. By Wilder D. Bancroft. (In press.)

No. 14. The relation of pure science to industrial research. By John J. Carty. October, 1916. 16 pages.

In these two series of the council publications approximately 18,500 copies have been distributed during 1920. The receipts for subscriptions to the Bulletin and separate sales of Bulletin and numbers in the Reprint and Circular Series total $1,040 for the year.

In pursuance of the policy of assisting with the dissemination of important scientific data, the council issued during the year among its miscellaneous publications "A bibliography of investigations bearing on the composition and nutritive value of corn and corn products" by M. Helen Keith. This bibliography was mimeographed in 200 copies. It is available through the publication office.

During the current year, approximately 130 pages of minutes, committee reports, and special articles have been published by the Research Council in the Proceedings of the National Academy of Sciences.

The executive board of the National Research Council, in December, 1920, approved the following recommendations relative to the

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relations of the National Research Council and the Proceedings of the National Academy of Sciences, with the understanding that the pages of the Proceedings are open to scientific contributions from all sources under the same conditions, and that the total contribution of the National Research Council to the Proceedings for the calendar year 1921, including subscriptions, shall not exceed $2,500:

1. That the National Academy of Sciences and the National Research Council cooperate in the publication of the Proceedings, beginning with Volume VII.

2. That the material published in the Proceedings consist only of articles in brief form of permanent scientific value.

3. That the management of the Proceedings be vested in an executive committee of three, consisting of the managing editor as chairman, for a term of one year, of a representative of the Academy, and a representative of the National Research Council, each to be appointed for a term of three years.

4. That the editorial board consist of the home secretary and the foreign secretary of the Academy, the chairman and the permanent secretary of the Research Council as ex officio members, and in addition of 10 representatives of the Academy and 7 representatives of the National Research Council, these numbers corresponding to the number of sections of the Academy and the number of divisions of science and technology of the Research Council.

5. That, beginning with Volume VII, the financial responsibility of the Proceedings be shared equally by the National Academy of Sciences and the National Research Council.

6. That, beginning with Volume VII, the operation of the Proceedings be placed upon a budget basis, the size of the volume in any year to be determined by the conditions of the budget, the equal amounts contributed by each organization being determined by mutual agreement before the beginning of each calendar year.

7. That the managing editor of the Proceedings be appointed by the council of the Academy and the executive board of the National Research Council upon the nomination of the editorial board.

During 1920 the Research Council appropriated approximately $2,500 for the support of the Proceedings of the National Academy of Sciences, in return for which copies of the Proceedings were sent to each member of the council and certain space for publication of council materials was provided. For the support of Botanical Abstracts the sum of $1,500 was appropriated. To promote and facilitate the establishment of a Scientific Instrument Journal the council agreed in December, 1920, to make a loan not to exceed $4,000, to be repaid from the earnings of the publication on condition that there should be set up an advisory editorial board representing the council. Final arrangements for the establishment of this journal have not yet been concluded. In December, 1920, the council appropriated $1,000 to assist the Wistar Institute in a special distribution of certain biological journals in foreign countries.

PUBLICITY.

In order to assist in making the existence and the activities and plans of the National Research Council more widely known the committee on publicity has sent out at various times during the year press

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releases to the newspapers and scientific and technical journals of the country. This committee has also maintained a special department in the Scientific American Monthly in which accounts of some of the scientific activities of the council, together with other articles on special phases of science, have been published.

WIRELESS TELEPHONY EXHIBIT.

In February an exhibit illustrating the history of the invention and perfecting of wireless telephony was installed in the rooms of the National Research Council in Washington and remained open to the public until late in April. It was then transferred to the American Museum of Natural History in New York, and later to the Art Institute in Chicago.

LECTURE BY MR. J. J. CARTY.

In connection with the wireless telephony exhibit, just referred to, a lecture under the auspices of the National Research Council was given on February 6 in the auditorium of the National Museum by Mr. J. J. Carty, vice president of the American Telephone & Telegraph Co. The lecture was illustrated by certain important pieces of apparatus, some of them of great historical value, and by a demonstration of speaking moving pictures. It was attended by a large audience.

SCIENCE SERVICE.

With the financial support of Mr. E. A. Scripps of Miramar, Calif., a Science Service for the dissemination by newspapers, magazines, lectures, motion pictures, conferences, etc., of authentic popular science has been organized under the joint auspices of the National Research Council, the National Academy of Sciences, the American Association for the Advancement of Science, the Scripps estate, and a group of professional journalists. The service is managed by a board of trustees of 15 members, three selected by each of the five groups above mentioned, of which Dr. W. E. Ritter, of the Scripps Institution at La Jolla, is president and treasurer, and Dr. Vernon Kellogg, of the National Research Council, vice president and chairman of the executive committee. The editor and secretary is Dr. E. E. Slosson, formerly associate editor of the Independent (New York), and the manager, Mr. Howard D. Wheeler, formerly managing editor of Harpers Weekly. The present headquarters of the service is Washington, with temporary offices in the rooms of the National Research Council.

CONFERENCE ON INDUSTRIAL PERSONNEL RESEARCH.

A preliminary conference on industrial personnel research was held on November 12, 1920, in the rooms of the National Research Council under the auspices of the council and Engineering Founda-

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tion. The expenses of this conference were met by a gift to the National Research Council of $1,000.

The conference was attended by 40 representatives of associations and organizations interested in problems connected with industrial personnel. These included organizations of labor, capital, managers, engineers, scientists, educators, economists, and sociologists. The chief question under discussion was the practicability of conducting research relating to men and women in industry and commerce, from management to unskilled labor. Such topics as the relations of persons doing different parts of the work and the influence of working conditions upon the health, output, and happiness of the workers are examples of those which were considered possible to be made subjects of research. The underlying ideas which led to the conference were the advantages of studying such questions by the scientific methods of gathering facts and using them to reach conclusions, instead of discussing opinions and propaganda, and the need for cooperation among organizations and individuals engaged in such studies.

Prepared papers were presented by Dr. James R. Angell, president of the Carnegie Corporation, on "Reasons and plans for research relating to industrial personnel," and by Mr. Samuel Gompers, president of the American Federation of Labor, on "Cooperation of workers in studies of industrial personnel matters."

Mr. Robert W. Bruere, chairman of the committee on present status of industrial personnel research, which had been appointed in advance, presented a report giving information about the growth of research relating to personnel in industry and some of the organizations which carry it on.

A very full discussion of these papers was had and resolutions were adopted stating it to be the sense of the conference that a personnel research federation should be established as soon as may be practicable.

CONFERENCE ON INTERNATIONAL CATALOGUE OF SCIENTIFIC LITERATURE.

A conference to consider the future of the International Catalogue of Scientific Literature was held in the rooms of the Royal Society in London on September 28 and 29, 1920. This conference was attended by representatives from Denmark, England, France, Japan, Norway, Sweden, Switzerland, United States, India, New Zealand, Victoria, and West Australia. The delegates from the United States were Dr. Robert M. Yerkes, representing the National Research Council; Dr. L. E. Dickson, representing the National Academy of Sciences; and Mr. L. C. Gunnell, representing the Smithsonian Institution. At this conference it was unanimously agreed to recommend that the

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International Catalogue of Scientific Literature should be temporarily continued in its present form for the year 1915 and possibly also as a single issue for the period 1916–1920, provided adequate financial support can be obtained, and that at the earliest possible date opportunity be taken to reconsider the whole character of the subsequent work of the organization.

It was also unanimously agreed that, inasmuch as the Royal Society is no longer able to accept financial responsibility for the catalogue, it is essential that adequate financial support, including working capital, be provided.

On the basis of these agreements the conference resolved that a committee be appointed to draw up definite proposals in accordance with the agreements made; that the report of the committee be forwarded to the council of the Royal Society and that the council of the Royal Society be requested to take such steps with regard to the recommendations of this committee as they think fit.

The committee appointed under this resolution made the following recommendations, subject to adequate financial provision being assured: (*a*) That the central bureau be instructed to proceed with the publication of the 1915 issue; (*b*) that the central bureau be further instructed to collect material for the period 1916–1920 with a view to the early publication of the issue of 1916–1920.

The committee further recommended that the council of the Royal Society request the executive committee of the international council of the catalogue to proceed to collect information as to the various issues raised in the foregoing resolutions of the conference and to report at as early a date as possible.

At a meeting of the interim committee of the National Research Council on November 6, 1920, following a report by Dr. Yerkes on the conference, the following motion was adopted:

That the National Research Council recommend to the council of the National Academy of Sciences that the Academy approve the action of the London conference September 28–29, 1920, on international catalogue and attempt to secure a grant of $25,000 to apply toward the cost of completing the International Catalogue of Scientific Literature during the year 1920, in accordance with the recommendations of the London conference.

INTERNATIONAL AUXILIARY LANGUAGE.

At the Brussels meeting of the International Research Council in July, 1919, a committee was appointed to investigate and report on the present status and possible outlook of the general problem of an international auxiliary language and authorized to cooperate in its studies with other organizations engaged in the same work. Dr. F. G. Cottrell, chairman of the division of chemistry and chemical technology of the National Research Council, was made chairman of the committee. The work of the committee has therefore centered so

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far in the offices of Dr. Cottrell in the National Research Council. For the clerical assistance necessary to carrying on correspondence and work of the committee Dr. Cottrell has secured funds from gifts from various private sources. The committee has secured cooperation through the appointment of a special committee of the British Association for the Advancement of Science and similar committees from the American Association for the Advancement of Science and the American Council on Education, besides securing active support from several American universities. The Classical Association of Great Britain and the Classical League of America have also appointed committees on the subject. At the meeting of the executive board on April 25, 1920, the chairman of the council was authorized to appoint a representative of the National Research Council on a special joint committee to make a preliminary study of the general subject of an international auxiliary language, to be composed of representatives of the National Research Council, the National Academy of Sciences, and the American Association for the Advancement of Science.

It is the purpose of the International Research Council's committee to make a broadly constructive and nonpartisan study of the whole subject of international auxiliary language.

EXTENSION OF MEMBERSHIP OF THE EXECUTIVE BOARD.

At a meeting of the executive board, October 12, 1920, on recommendation previously made to the board by the interim committee, a special committee on revision of membership of the executive board was appointed, of which Dr. James R. Angell was made chairman and Messrs. E. D. Adams, Gano Dunn, Vernon Kellogg, and J. C. Merriam members. The purpose of this committee is to consider the advisability of extending the membership of the executive board so as to include a larger representation on it of the leaders of science, commerce, and industry not otherwise connected with the council. So large a part of the membership of the board at present consists of the general officers of the council and chairmen of its divisions that it was felt desirable to bring into the board a larger number of men whose interests were not already specifically committed to particular parts of the council's activities. A report of progress was made by this committee on December 14, but a final report from it has not yet been submitted to the executive board.

JOINT COMMITTEE WITH THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE ON ABSTRACTING AND LISTING SCIENTIFIC LITERATURE.

In April, 1920, the National Research Council and the American Association for the Advancement of Science appointed a joint com-

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mittee to consider the matter of abstracting and listing scientific literature. This committee met in May and prepared a report which was formally presented to the executive board of the National Research Council in December.

In the meeting of this committee special attention was given to the relation of the Concilium Bibliographicum (Zurich, Dr. H. H. Field, director) to the work of abstracting and listing scientific literature. The financial difficulties under which the Concilium Bibliographicum have labored for some years seem to make it necessary that special support be found for the concilium. In this connection it seemed advisable to review the work of the concilium and to consider if an arrangement could not be made whereby its work might be widened.

The report of the joint committee recognized that the Concilium Bibliographicum should be perpetuated and might well serve as the nucleus of a proposed international institute for scientific bibliographic work. This committee decided that the National Research Council, because of its type of organization and its international connections, is the most suitable American agency to become responsible for the initiation of the international abstracting and listing of scientific literature. The officers of the council, therefore, have had several conferences with a philanthropic foundation to consider the financing of such an institute with the Concilium Bibliographicum as a nucleus, and have met with a cordial response from this foundation. Negotiations are now under way which it is hoped will lead to a satisfactory arrangement for financing the proposed work for a number of years.

COMMITTEE ON PREPARATION OF INTELLIGENCE TESTS FOR ELEMENTARY SCHOOLS.

This committee has completed the preparation of two scales for use in grades 3 to 8. Early in 1920 arrangements were made with the World Book Co., of Yonkers, N. Y., for the publication of materials necessary in connection with the methods which had been developed.

The commercial royalty from these publications, which are to be known as the National Intelligence Tests, is to be paid to the National Research Council for the support of similar research on methods of psychological examining.

During the spring of 1920 an extensive experiment, the purpose of which was to supply data for the equalizing of five alternative forms of each of the intelligence scales, was conducted in the schools of Washington, D. C. Subsequently the scales were standardized, with the cooperation of Messrs. J. F. Guy and J. L. Stenquist and Dr. Helen T. Woolley, by their application in the schools of Washington, Pittsburgh, New York, and Cincinnati.

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The record blanks for Form 1, scale A, and Form 1, scale B, scoring keys, and a Manual of Directions were finally prepared for press during the summer and published in August, 1920. The Manual contains, in addition to instructions for the administration of the tests, age and grade forms for Washington and Pittsburgh and tentative general age standards.

The manuscript for four additional alternative forms of scale A and likewise of scale B has been prepared for publication, and it is anticipated that Form 2 of each scale, with appropriate scoring keys and revision of the Manual of Directions, will be published early in 1921.

After 1920 the work on intelligence tests for elementary schools will be conducted under the auspices of the division of anthropology and psychology. The original special committee appointed by the executive board of the council, prior to the organization of the division of anthropology and psychology, has been constituted a committee of the division. The continuation of this work will be financed from the royalties received from the National Intelligence Tests.

COMMITTEE ON PACIFIC EXPLORATION.

The committee on Pacific exploration was authorized by the executive board of the council in June, 1918, to consider the need for research and exploration in and around the Pacific, the best methods for cooperation in furtherance of present work, and in the initiation of new plans. The first important subject to come before this committee was an invitation from the Territorial Government of Hawaii to call a scientific conference in Honolulu. Such a congress was organized on an international scale, meeting in Honolulu in August, 1920. The countries represented were Australia, Canada, Japan, New Zealand, Philippine Islands, and the United States. The deliberations of this body resulted in a report on the problems most urgent in the Pacific and recommendations as to how they can best be taken up.

At a subsequent meeting of the committee in Washington a recommendation was made to the executive board that its responsibilities be delegated to the division of foreign relations. This recommendation was approved and a new committee under this division was appointed, to be known as the committee on Pacific investigation.

AMERICAN GEOPHYSICAL UNION.

The American Geophysical Union, organized in 1919, to serve as the "American national committee" of the International Geodetic and Geophysical Union, and to serve also as the committee on

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geophysics of the National Research Council, comprises seven sections, as follows: (*a*) Geodesy, (*b*) seismology, (*c*) meteorology, (*d*) terrestrial magnetism and electricity, (*e*) physical oceanography, (*f*) volcanology, and (*g*) geophysical chemistry. The last of these, section (*g*), was added to the union early in 1920 to make provision in the union for geophysical activities previously without representation in it. Originally organized as a committee of the division of physical sciences, the American Geophysical Union was, on February 14, 1920, made a committee of the executive board of the council in recognition of the breadth of interest of the sciences drawn together in its organization. The union held its first annual meeting on April 23, 1920, when its organization was completed and ratified by action of its assembled members. The function of this body is to represent the National Research Council and to care for the interests of the United States in the deliberations and activities of the International Geodetic and Geophysical Union, and to act as an advisory and initiatory body in promoting the advancement of geophysics in the United States.

DEATH OF CHAIRMAN BUMSTEAD.

Dr. H. A. Bumstead, professor of physics and director of the Sloane Physical Laboratory at Yale University, and chairman of the National Research Council for the year July 1, 1920, to June 30, 1921, died suddenly in the night of December 31, 1920, on a train which he had taken from Chicago to return to Washington.

The following resolution was unanimously adopted by the interim committee of the council on January 3, 1921:

Resolved, That the National Research Council learns of the death of Dr. Henry Andrews Bumstead, chairman of the council, with great sorrow and profound sense of loss. Dr. Bumstead in his association with the council had revealed to its officers and members not only a high capacity for administration, and a most loyal fidelity to the aims and work of the council, but also a sweetness of disposition and personal attractiveness which had won for him the devoted and affectionate regard of all of his colleagues in the council. In his death the council and the scientific world lose a man of most eminent attainments, highest character, and lovable personality.

The National Research Council extends to the bereaved wife and family its deepest sympathy and condolence and wishes to express to them its full appreciation of the great value of the services which Dr. Bumstead rendered it in the period of his association with it and the great loss which it suffers by his untimely death. But may we all remember that "that life is long that answers life's great ends."

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REPORTS OF DIVISIONS.

DIVISIONS OF GENERAL RELATIONS.

DIVISION OF FEDERAL RELATIONS.

[CHARLES D. WALCOTT, *Chairman.*]

(For present personnel, see Appendix A.)

The division of Federal relations was provided for in the organization of the National Research Council to carry out the provisions of the Executive order of the President of the United States of May 11, 1919, that effective prosecution of the council's work requires cordial cooperation of the scientific and technical bureaus of the Government, both military and civil. It was first called the division of Government relations and later the division of Federal relations.

At a meeting held on December 17, 1920, Dr. Augustus Trowbridge was elected secretary in place of R. M. Yerkes, resigned, and the following new appointments to fill vacancies were announced: Mr. Wilbur J. Carr, to succeed Mr. Julius G. Lay as representative of the Department of State; Brig. Gen. Dennis E. Nolan to succeed Gen. Churchill as representative of the Military Intelligence Division of the Department of War; Rear Admiral Edward R. Stitt to succeed Admiral Braisted as representative of the Medical Corps of the Navy Department; Capt. C. C. Bloch to succeed Admiral Earle as representative of the Bureau of Ordnance of the Navy Department; Mr. Chester D. Jarvis to succeed Dr. Capen as representative of the Bureau of Education of the Interior Department; Mr. Earl H. Clapp to succeed Dr. Graves as representative of the Forest Service of the Department of Agriculture; Mr. Ethelbert Stewart to succeed Dr Meeker as representative of the Department of Labor.

The division, as it stands on December 31, 1920, has as members representatives from the following departments of the Government:

Department of State:
- Foreign Intelligence Division.

Department of the Treasury:
- Public Health Service.

Department of War:
- Military Intelligence Division.
- Surgeon General's Office.[1]
- Corps of Engineers
- Ordnance Department.
- Signal Corps.
- Coast Artillery.[1]
- Air Service.
- Chemical Warfare Service.

Department of Justice:
- Division of Investigation.

Post Office Department:
- Division of Correspondence.

Department of the Navy:
- Office of Naval Intelligence.[1]
- Bureau of Navigation.
- Bureau of Ordnance.
- Bureau of Construction and Repair.
- Bureau of Steam Engineering.
- Bureau of Medicine and Surgery.
- Bureau of Yards and Docks.

Department of the Interior:
- Patent Office.
- Bureau of Education.
- Geological Survey.
- Reclamation Service.
- Bureau of Mines.

Department of Agriculture:
- Weather Bureau.
- Bureau of Animal Industry.

[1] Representative not yet named.

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Department of Agriculture—Continued.
Bureau of Plant Industry.
Forest Service.
Bureau of Chemistry.
Bureau of Soils.
Bureau of Entomology.
Bureau of Biological Survey.
Bureau of Public Roads.
Department of Commerce:
Bureau of the Census.
Bureau of Standards.
Bureau of Fisheries.
Coast and Geodetic Survey.
Department of Labor:
Information and Education Service.
Smithsonian Institution.

The personnel of the division will be found in an appendix of this report, together with that of the executive committee provided for last year.

Progress has been made in three important problems under consideration at the close of last year—the establishment of an information service of liaison representation from the various Federal departments, the securing of closer contact among the bureaus interested in the statistical work of the Government, and the investigations of the joint committee upon relations between scientific agencies in Federal and State Governments.

The recommendation of the joint committee upon relations between scientific agencies in Federal and State Governments was that a general report should be prepared showing the channels which have thus far been developed for research and for the application of scientific knowledge through cooperation between Federal and State agencies. The recommendation was approved, and the report when completed will be published as a bulletin of the National Research Council.

The division has given consideration to the problem to make suggestions as to what research should be undertaken by the Government, what should be left to the universities, and what to the industries. To contribute toward a solution of the problem, a committee on scope of Government service was appointed to make a broad survey of scientific bureaus of the Government and recommend a research policy.

DIVISION OF FOREIGN RELATIONS.

[GEORGE E. HALE, *Chairman.*]

(For present personnel, see Appendix A.)

During the year the division of foreign relations has assisted in the formation of American sections of the International Mathematical Union and of the International Union of Scientific Radio Telegraphy, contributing toward the expenses of the American representative, Prof. L. E. Dickson, of the University of Chicago, at the organization meeting of the International Mathematical Union in Strasbourg in September, 1920. Material has been assembled in preparation of a pamphlet to give essential information concerning all of the international scientific and technical societies, and particularly those in which the United States is taking part.

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The division this year has had to consider the matter of necessary American support, through the payment of dues, for the maintenance of the International Research Council and certain of its associated unions. These bodies, in so far as organized, are the International Research Council, the International Astronomical Union, the International Union of Pure and Applied Chemistry, the International Union of Geodesy and Geophysics, the International Mathematical Union, and the International Union of Scientific Radio Telegraphy.

The council has been able to pay the American dues for these organizations for the current year by a gift from the William Ellery Hale fund. But as the dues from most other countries included in these international organizations are paid by the Governments of the participating countries, the division of foreign relations has carried on negotiations with the Department of State looking toward the payment of these dues in future years by the Government of the United States. The sympathetic attitude of the Department of State has resulted in the introduction by the department in its current appropriation bill of an item for the payment of the next year's dues. Just as this report is being prepared the House committee of Congress has presented this item for the approval of the House in the Diplomatic and Consular appropriations bill.

The division has been closely in touch with the work of the council's special committee on Pacific exploration and has recommended that this committee be reconstituted and attached to the division of foreign relations on account of the fundamental international relations which will be involved in the work of this committee.

With the cooperation of the Research Information Service, the division is also engaged in the attempt to arrange for international cooperation in abstracting and listing scientific literature by the most efficient and convenient methods.

DIVISION OF STATES RELATIONS.

[JOHN C. MERRIAM, *Chairman.*]

(For present personnel, see Appendix A.)

The work of the division of States relations during 1920 has been directed upon two problems:

1. A study of the facilities for research at the command of scientific departments in State governments, such as boards of health, boards of agriculture, fish and game commissions, conservation commissions, offices of the State forester, State geologist, State highway engineer, etc. This inquiry includes also a study of the forms of State government in so far as the organization and relationship of these departments is concerned in order to ascertain whether the governmental

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machinery provided by the States affords the best means for developing scientific knowledge and promoting its application.

Reports upon the organization and activities of research activities are in process of preparation for 10 States. It is believed that in certain cases the best interests of this movement for strengthening the position of science in State governments can be assisted by the publication of reports of this nature. Arrangements have already been made for the publication of the first of these statements, which comprises a report upon the organization and activities of the scientific departments of California.

2. A study of the nature and extent of the cooperation in scientific work between Federal bureaus and corresponding State scientific departments or other non-Federal agencies. This project has been undertaken jointly with the division of Federal relations.

It is hoped that the results of these studies can be made useful in connection with the present movement for the reorganization and consolidation in State government by indicating ways in which the organization of State scientific departments may be improved and their relationships to each other and to other agencies can be made more effective, their research power and output increased, and their activity in the application of scientific knowledge to the public welfare extended.

DIVISION OF EDUCATIONAL RELATIONS.

[VERNON KELLOGG, *Chairman.*]

(For present personnel, see Appendix A.)

The principal undertaking of the division during 1920 has been the continuance of the survey of the research conditions in the colleges and universities of the country. This survey has been made by correspondence and especially by personal visits. One hundred and sixteen colleges and universities have been visited by nine representatives of the council, of which six were chairmen of council divisions. The carrying on of the survey has been made possible by the financial support of the General Education Board.

While conducting the survey, which seemed necessary before planning and entering on any extensive program for the encouragement of research and the training for research work in educational institutions, a beginning has been made in the encouragement of the establishment and cordial administrative and financial support of special research committees in the colleges and universities. About 60 of these committees now exist, a few of prewar standing, some established during the war, and some since the beginning of the division's survey work.

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A gratifyingly cordial response has been received by the division from the colleges and universities in the course of its activities, especially in connection with the personal visits of its representatives and with its efforts to encourage the development of research committees.

In November an executive committee of the division was formed, which met in December and authorized the active prosecution of a plan whereby the division, in cooperation with the division of anthropology and psychology, proposes to institute a study of the possibilities in connection with the discovery and special encouragement of upper-class students especially capable of development into research workers. As a first step in the study, Dr. George W. Stewart, professor of physics in the State University of Iowa, will devote most of his time in the first half of 1921 to visiting a number of colleges and universities in States in the Mississippi and Ohio Valleys to discuss the matter with administrative officers, faculty members, and students.

Certain special reports, prepared and distributed for the purpose of stimulating interest in and comment on the research situation in the colleges and universities, have been sent by the division to college and university presidents, deans of graduate schools, and chairmen of research committees. These reports have been given much attention and have brought to the division a most enlightening series of critical comments and constructive suggestions.

Altogether the division feels that it has a right to believe that its efforts are helping to stimulate a special interest among scientific men and university authorities in the present research situation in the institutions of higher education in the country, a situation which just now may fairly be regarded as critical.

DIVISION OF RESEARCH EXTENSION.

[HARRISON E. HOWE, *Chairman.*]

(For present personnel, see Appendix A.)

With but few exceptions the tasks undertaken by the division of research extension are long-time projects requiring considerable periods of time, not only for their completion, but for their actual organization. In addition to projects originating with the division or taken over by it at the suggestion of others, there are frequent calls upon it to assist various other divisions, notably those of science and technology, in perfecting plans for organizing work and in devising ways and means for securing necessary finances. The officers of the division are also called upon to render assistance on numerous committees of the council and to take over a large part of the work in a number of important cases.

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The following activities may be noted, and these will serve to illustrate the type of work which falls within the field of the division of research extension.

Critical tables of physical and chemical constants.—The project to compile, and publish in English, critical tables of physical and chemical constants originated with the International Union of Pure and Applied Chemistry of the International Research Council, and is America's contribution toward the effort to provide better tables of scientific data and source books in the English language. Following a report by a special committee of the division of chemistry and chemical technology, a board of trustees was appointed—H. K. Moore, representing the National Research Council, Julius Stieglitz, representing the American Chemical Society, and E. P. Hyde, representing the American Physical Society. To this group the chairman of the division of research extension was added in June, 1920, and later made executive secretary.

The present work of the trustees is principally that of securing a fund of $200,000 which is to underwrite the very considerable work necessary in preparing and publishing the volumes of constants. Literature has been prepared by Mr. Paul Moore, secretary of the division, and at the close of the year there had been obtained in money and service pledged the equivalent of a little more than 45 per cent of the total budget of $200,000.

During the latter part of 1920 the organization of the work was carried forward by the selection of representatives in various industrial centers, and steps were taken to interest chemists, physicists, and engineers in supplying information as to the importance of constants and preparing the way for securing subscriptions.

It is believed that the publication of such tables affords one of the most direct and immediate means for stimulating research, and a great deal of attention, therefore, is being given this project.

Crop protection institute.—In May, members of the division of biology and agriculture brought to the attention of the chairman of the division of research extension the opportunity for cooperation between scientific groups and industrial groups interested in the control of injurious insects and plant diseases. Subsequently a conference was called in Rochester, N. Y., and a tentative constitution outlined and circulated among those interested. This was followed in September by a well-attended meeting in Washington, where the constitution was ratified. The first meeting of the institute following this organization was held in New York in December, at the request of officers in the Bureau of Entomology, Department of Agriculture, to discuss ways and means to standardize calcium arsenate, and methods for its application in the control of the boll-weevil in the cotton districts. This meeting was well attended by both ento-

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mologists and manufacturers of the arsenate and dusting appliances, and it was the concensus of opinion that the meeting was very successful and demonstrated the good that could come from the cooperative methods of the institute.

Later in December it became apparent that the scope of the institute would have to be broadened to care for new industrial groups interested in the control of insects and plant diseases, but not manufacturers of insecticides and fungicides, and preliminary steps were taken working toward the necessary revision of the constitution.

Alloys.—A proposal to form an Alloys Research Association was the first definite project of the division, and during 1920 a number of difficulties which seemed to confront the plan were overcome, and at a largely attended conference of representative metallurgists with the division it was decided to organize an informational service as the first activity of the association. This work was intrusted to a special committee cooperating with the division of engineering and a tentative constitution and by-laws outlined under which the association is now being organized.

There have been several conferences with industrial and other interests regarding the matter, and, at their suggestion, the management of the association has been vested in a committee chosen from the divisions of engineering, chemistry and chemical technology, and research extension.

The informational service of the Alloys Research Association is regarded by the division as an experiment in assembling and disseminating specialized knowledge with the hope that this activity will speedily lead to cooperative research undertaken by the members of the association as a means of answering important questions which can not be answered from the literature.

Tanning.—The Tanners' National Council, which has supported a research laboratory for some time, has become interested in the possibility of founding a school of tanning, a plan to accomplish in the United States objects similar to those of the tanning schools abroad. Through the activities of the division of research extension, the council has requested the National Research Council to assist them with their problem of deciding upon the type of school, its field of activity, its location, etc.

With respect to the research laboratory of the Tanners' National Council, this is now being reorganized under an arrangement with the University of Cincinnati, and it is expected that it will undertake a new series of problems with promise of success.

The chairman of the division has also been in conference with State authorities of Massachusetts where the possibility of establishing a trade school for tanning is under consideration.

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Tobacco.—There are large annual losses in the tobacco industry from diseases which are not well understood, and the desirability of supporting research plans to produce better disease-resisting strains was brought to the attention of the division. Steps have been taken to interest large tobacco concerns and tobacco growers. It is too early to predict success for the project, but those who have been made acquainted with it are much interested in the possibilities, and the work of organizing the project is still under way.

Forestry.—During the year $10,000, covering a period of three years, was secured from the Southern Pine Association for the support of the work of the committee on forestry, division of biology and agriculture. Subsequently field work was organized under a regional director in the South and the research is under way.

Glass.—Following a suggestion made to the American Ceramic Society, division of glass technology, a cooperating committee of three has been appointed by that society to consider whether or not there is an opportunity in America for cooperating research on the fundamental problems of glass making. This committee is now obtaining suggestions from those concerned in glass making, so that definite recommendations may later be made to the industry for the support of a definite research program should it be found desirable to initiate cooperative research on glass problems.

Macaroni.—During the year the chairman of the division was invited to attend the annual meeting of the Macaroni Manufacturers' Association, and there had an opportunity to take part in the movement to secure the services of a specialist to work upon some of the problems incident to the manufacture of macaroni and alimentary pastes. This is but the beginning of what may be expected to become an important research and control laboratory supported by an organization of manufacturers in this special field.

Cotton and textiles.—Work has continued with reference to interesting the textile industry in the application of science to its production problems. Contact has been made with the National Wool Manufacturers' Association through its secretary, for whom information has been secured, and an effort is being made to assist him in having the industries engage upon certain problems which they have selected as important for their progress.

The chairman of the division serves as secretary to the preliminary committee on American cotton research authorized by the world cotton conference, and appointed by the chairman of the National Research Council, the presidents of the American Society for Testing Materials, the National Association of Cotton Manufacturers, and the American Cotton Manufacturers' Association. This committee has met, has enlarged the membership, and is at present engaged in learning those problems which are outstanding in the cotton field,

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with a view to forming a definite program for presentation with a budget to those who should be interested.

Through Mr. Paul Moore, secretary of the division, a census has been taken of the textile research facilities of the country, and a great deal of effort has been expended with a view to really interesting all those concerned with cotton growing and manufacture in sustained research.

Cooperation of the division has been given the American Home Economics Association in evolving their plan for establishing minimum standardization for those fabrics which make up the principal part of the wardrobe, and the facilities of the division have also been offered the textile division of the Bureau of Standards in the pursuit of their research program.

Assistance to individual manufacturers.—The officers of the division have been called upon to advise and assist manufacturers desiring to expand their research organizations, to install new laboratories, or to get in touch with those capable of rendering assistance on their manufacturing problems.

The division has also offered to assist certain industrial associations, including the American Gas Institute and the manufacturers of enameled metal ware. They have also taken steps to familiarize farmers' organizations with the purpose, work, and facilities of the council with special reference to the division of biology and agriculture and its committee on food and nutrition.

Miscellaneous.—Contact has been maintained with the American Institute of Baking, in which the division has been interested from the inception of the institute, and some attention has been given the work to increase the facilities at the Marine Biology Laboratory, with special reference to biochemistry and biophysics.

Efforts have been made to assist other scientific activities, such as the Mulford expedition to South America under the leadership of Dr. Rushby, the organization of the Tropical Institute, the food and nutrition program of the division of biology and agriculture, and various projects of other divisions.

During the year the chairman of the division has made a number of addresses before industrial and scientific groups on the general work of the council and on that of the division in particular, and has also contributed a number of papers to the technical and lay press.

Exhibits.—In February the wireless telephone exhibit was installed in the rooms of the Research Council in Washington, and remained there for some time, attracting a great deal of interest and favorable comment. It was then transferred to the American Museum of Natural History in New York, where it appeared under the auspices of the division of physics, New York Academy of Sciences.

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During the meeting of the American Association for the Advancement of Science the exhibit was installed at the Art Institute in Chicago at the special request of the American Association.

The purpose of the exhibit is to emphasize the necessity for supporting fundamental research, and its appearance was made possible by the American Telephone & Telegraph Co., the Western Electric Co., the Signal Corps and the Air Service of the United States Army.

During the year the work of the division increased to the point where it was necessary to secure a secretary, and the division was fortunate in obtaining the services of Mr. Paul Moore.

RESEARCH INFORMATION SERVICE.

[ROBERT M. YERKES, *Chairman.*]

(For present personnel, see Appendix A.)

The service as now organized consists of (1) a divisional committee of 39 members, (2) an executive committee of 7 members, (3) a resident staff of 8 members. This resident staff is supplemented importantly by the cooperative assistance of the chairmen of the other divisions of the National Research Council, who act as advisors and consultants in matters pertaining to their respective fields of science and technology.

The research information service has been organized primarily as a general clearing house for information concerning or affecting scientific and technological research. The chief purpose of the service is to advance science and productive scholarship by supplying individuals, institutions, or firms with desired information concerning results of research, problems, projects, methods, procedures, laboratory construction and equipment, apparatus, publications, funds, sources of information or advice, personnel, et cetera.

Every effort is being made to avoid duplicating the work of other informational agencies and to coordinate and utilize their activities and materials in connection with the demands made upon this service. It was originally believed, and it now appears that this belief is justified by the facts, that an expert informational service can be made to encourage profitable cooperation in research, to lessen undesirable duplication of work, to increase the support of fundamental scientific investigation, to promote exchange of information concerning progress in closely related investigations, and to render possible increasingly satisfactory distribution of research effort and greater wisdom in selection of problems for investigation.

During the year 1920 the service has replied to approximately 500 requests for information or advice. In almost every instance it was possible to supply either wholly or in part the information which was sought.

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In addition to answering specific inquiries the staff of the service has compiled and prepared for publication certain obviously important scientific data. It has also continued to develop and perfect the fundamental informational lists and catalogues which were initiated last year.

Of the compilations of information referred to above, the following are typical. Each task was undertaken by reason of repeated requests for the information in question.

1. A list of industrial research laboratories in the United States with important information concerning each. This was compiled by Mr. A. D. Flinn with the cooperation of Miss Ruth Cobb, of the Research Information Service, and published as a bulletin of the National Research Council. The demand for this list has been unexpectedly heavy and the prompt exhaustion of the original edition has encouraged the service to hasten the preparation of a second edition, which will include many more laboratories than the original publication.

2. A list of scientific periodicals which publish bibliographies and abstracts has been compiled by Miss Ruth Cobb and published in the bulletin of the National Research Council.

3. In response to varied and numerous requests concerning sources of grants for scientific research, research institutions and foundations, the service has assembled information concerning funds which are available for medals, prizes, grants, scholarships, fellowships, and other forms of appropriation for the encouragement and support of research in the mathematical, physical, and biological sciences. This compilation is in press and will appear as Bulletin No. 9.

4. To meet varied needs, some of which have been expressed by correspondents, reliable information concerning the cost of publication and the financial status of approximately 80 of the principal scientific periodicals in the United States has been assembled and filed for consultation in connection with the study of problems of publication and the support of scientific periodicals.

5. As one method of keeping the research personnel file of the service complete and up to date, a list of doctorates of science and philosophy for 1919 has been compiled by Miss Callie Hull. This information, in addition to being made available in the files of the service, has been published in Science, November 19 and 26, 1920.

Information, unless assembled to meet a specific request, is compiled for one or both of the following reasons: To render available in the research information service a complete up-to-date file, as, for example, in the case of research laboratories, research personnel, research funds, or to obtain material suitable for publication and distribution. Ordinarily, publication is merely a convenient method

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of rendering the immediately available information readily accessible to those who need it.

On the fundamental informational mechanisms, the development of which was undertaken during the first year of the service, report of progress is made below.

1. *Research laboratories.*—This list is planned to include all scientific and industrial laboratories in which investigations are conducted. Concerning each laboratory the following information ordinarily is available, in addition to name and address: Personnel, date of organization, classification as Federal, State, city, university, independent, and either scientific or industrial, rating as to equipment, space available, annual expenditure, chief lines of research provided for, and current investigations.

This list is rapidly being increased and the information concerning each establishment completed to date. The numbers of records for the several classes of laboratories follow: Industrial, 350; academic, 800; Federal, 275; State, 750; city, 360; independent, 175.

2. It was initially attempted to secure the titles of current investigations directly from investigators in order that information should be available concerning work which is in progress within a given field. This has proved to be unsatisfactory because of the annoyance to investigators and the incompleteness of returns. The files now contain approximately 1,500 records of current work, distributed as follows: Agriculture, 225; astronomy, 75; biology, 250; chemistry, 250; engineering, 100; mathematics, 30; medicine, 300; physics, 150; psychology, 50; miscellaneous, 50. This incomplete current investigation file is importantly supplemented by the research laboratory file, which for all of the principal research establishments of the country carries indication of the chief lines of investigation.

Thus far in the development of the service, relatively little attention has been given to data concerning research in Federal, State, or municipal laboratories, because this is to a considerable degree available through official reports and informational bureaus.

3. The personnel file contains essential information concerning approximately 13,000 men and women in the United States who are qualified by training and experience for scientific research. It is planned to perfect and keep this list up to date in order that it may be used both as a general source of information concerning scientific personnel and as a source of lists of eligibles for specified positions.

As an experiment in securing greater efficiency in the use of the personnel file, the records of one group of scientists are being translated into the Findex punch-card system.

4. The wisdom of the executive committee of the Research Information Service in urging the development of a library of scientific source books has been amply demonstrated by the experience of the

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year. Funds have not been available for the purchase of any except immediately and urgently needed books, but effort is being made to secure by exchange or gift valuable series of bibliographies or abstracts which are now in the library of the National Academy of Sciences. It is planned that this special library should ultimately contain all of the important bibliographic, abstracting, and reviewing periodicals for science and technology, and in addition the essential compilations of tables, handbooks, digests, catalogues, etc. No such collection of works for the field of the Research Council's interest is available in any single place in Washington, hence the extreme desirability of developing this projected library of sources as rapidly as the resources of the Research Information Service permit.

5. A list of informational bureaus and other agencies which are concerned partly or wholly with science and its applications is in course of preparation. This is utilized first of all to avoid undesirable duplication of informational activities, and secondarily as an aid to the satisfactory handling of specific informational inquiries. It is planned to include in the list not only specialized informational organizations but institutions, firms, and individuals which are recognized authorities on certain subjects.

Experience has indicated in connection with efforts to utilize existing sources of information that it is more satisfactory to assemble information and forward it directly to the correspondent than to refer his request to a supposedly dependable special source. The service, as a result of trial, has adopted the policy of assembling information, so far as is possible, instead of referring inquiries with the request that the information be sent.

6. The informational file concerning funds for the encouragement and support of productive scholarship has already been referred to in the section on compilations. It promises to become one of the conspicuously useful files of the service. This information, which is available nowhere else, is needed in connection with the action of special committees, boards, and other agencies which are responsible for the distribution of funds.

In order that the service may be self-improving, a system of classifying and filing inquiries and the information assembled in response thereto has been devised and put into effect. This system will enable the staff to locate and utilize promptly and conveniently any information which has come into the office, whether as the result of special search or by reason of the general activities and connections of the National Research Council.

During the initial stages of the development of the Research Information Service it was deemed desirable to prepare for actual service by formulating plans and assembling certain informational lists and catalogues. No formal announcement of the availability of

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the service was made until November 15, 1920, when a statement was issued for use in the scientific and technical press. The time has now come when the further development and improvement of the service must depend largely upon the creation of a demand for it and the guidance which inquiries supply.

DIVISIONS OF SCIENCE AND TECHNOLOGY.

DIVISION OF PHYSICAL SCIENCES.

[AUGUSTUS TROWBRIDGE, *Chairman.*]

(For present personnel see Appendix A.)

The organization of the division of physical sciences has been changed during the past year so that the membership of the division now includes one representative of the Mathematical Association of America and one more than the original number of members at large.

Since the appearance of the last annual report of the National Research Council there has been formed under the auspices of the division of physical sciences an American section of the International Mathematical Union and also, under the joint auspices of the division of engineering and the division of physical sciences, an American section of the International Union of Scientific Radio Telegraphy.

The project research committees made possible by the special grant of $20,000 by the Rockefeller Foundation were heartily indorsed by the division at its annual meeting in April, 1920, and the following new committees were formed during the year 1920: Acoustics, algebraic numbers, atomic structure, luminescence, theories of magnetism, orbit theory, parallaxes, research methods and technique, and spectroscopy. On December 31, 1920, the total number of research committees of the division was 16, with a total membership of approximately 100. Reports from some of the committees formed in the latter part of 1919 were in the hands of the printer by the end of 1920, and from that time on should appear from time to time and be distributed to the members of the societies represented on the division, and other interested persons, in the form of bulletins of the National Research Council. At the close of 1920 the Rockefeller Foundation was furnished with a detailed report of the activities of these research committees of the division, and made a further grant of $15,000 for the continuance of the project for the year 1921. The formation of further committees on borderland problems between physics and biology and between mathematics and the sciences using statistics is under consideration.

Since July 1, 1920, the chairman of the division has acted as the executive secretary of the fellowship board of the National Research Council. There were on December 31 15 fellows (4 in physics and 11 in chemistry). This represents an increase of 2 over the number

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on December 31, 1919. Of the present fellows, 10 are on their second appointment and 5 are on their first appointment. The indications are that there will be a large number of applications to be acted on at the spring meeting of the board which will be held in March, 1921.

There follows a list of the present fellows in physics, subjects of researches, and universities where work is being conducted:

Ernest F. Barker, "The fine structure of the infra-red absorption bands of gases." University of Michigan.

Leonard B. Loeb, "A study of the relations between the existence of so-called 'free' electrons in gases at low pressures, the abnormal mobility of negative ions at these pressures, and the mechanism of ion formation from electrons and neutral molecules." University of Chicago.

George P. Paine, "The measurement of free air humidities." Harvard University.

Louis T. E. Thompson, "General investigation of movement of small rigid bodies through fluids, etc." Clark University.

The project of the division for the founding of an instrument journal in connection with the Association of Scientific Apparatus Makers has not yet been carried to completion. The delay has been due to uncertainties as to costs and financial support and not to any lack of agreement between the council and the association as to the desirability of founding a journal which shall be supported by the association and edited by a board representative of the scientific interests centering on the council.

The project of the critical tables of physical and chemical constants, in which the division of physical sciences is jointly interested with the division of chemistry and chemical technology, is dealt with in another section of this report. (See Division of research extension.)

Two projects brought forward by the mathematical members of the division have been approved. These are campaigns for the securing of funds to start a journal of mathematical abstracts and for a revolving fund to aid in arranging for the publication of monographs. The council has subscribed $500 to each of these funds and will assist in securing the necessary further funds.

DIVISION OF ENGINEERING.

[COMFORT A. ADAMS, *Chairman.*]

(For present personnel, see Appendix A.)

Outstanding features are progress of researches in fatigue phenomena of metals and heat treatment of carbon steel, reorganization of American bureau of welding, organization of advisory board on highway research, creation of committees on electrical insulation and other important subjects, and progress in developing the organization of the division.

For each broad field there is a general advisory committee of experts from the interested scientific, engineering, and industrial

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organizations. This advisory committee, with the assistance of the division officers, selects specific problems for research, plans modes of attack, finds men and means, and coordinates the work of the various agencies. Work on each problem is under the supervision of a research committee, whose chairman is a recognized expert. Results are published in the journal of the engineering society most interested.

To stimulate interest in research, business of division meetings is curtailed and the time given to speakers on some phase of research. Executives of industries are invited as guests.

Administrative expenses of the division are paid partly by the National Research Council and partly by Engineering Foundation, but means for researches in general come from the interested industries, including services of staff engineers, laboratory facilities, and materials. To facilitate cooperation with the engineering societies and engineering foundation, the division has offices in the Engineering Societies Building, New York.

Work of Committees.

The following committees were active during 1920:

Heat treatment of carbon steel (Henry M. Howe, chairman).—Object: To increase our now fragmentary knowledge of the influence of heat treatment on the mechanical properties of carbon steel, and especially to learn the conditions which most economically and advantageously set up the sorbitic state, the most valuable for engineering purposes. Method: To subject specimens of steel of the carbon contents most used for engineering work, 0.34 per cent, 0.52 per cent, and 0.75 per cent, and most suited to sorbitizing, to various heat treatments, and to test the mechanical properties thus induced. The steels are the same as are used by the committee on fatigue phenomena. The tests are expected to show the merits of sorbitizing treatment over crude annealing. Progress: The work of this committee is an excellent illustration of cooperative research. Steel specimens are provided by the John A. Roebling's Sons Co., and rolled into round bars by the Carpenter Steel Co. The heat treatments and some microscopic examinations are being conducted in the private laboratory of Dr. Howe. Microscopic examinations are also made at the University of Minnesota. Magnetic tests are made at the Bureau of Standards. The test pieces are being machined by the Bureau of Mines at Pittsburgh, the Bethlehem Steel Co., the Neverslip Co., the General Motors Corporation, and the American Tool & Machine Co., without charge. The mechanical tests are being made at the Bureau of Standards and at the Watertown Arsenal.

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Physical changes in iron and steel below the thermal critical range (*Zay Jeffries, chairman*).—Object: To correlate experimental results on deformation of iron and steel in the blue heat range and physical changes in iron and steel at ordinary and slightly elevated temperatures accompanied by a change in physical properties usually called aging; to study the effect of temperature on the mechanical properties of iron and steel (particularly boiler plate). Method: Work is being carried on and directed by members at the plants with which they are connected. Materials are contributed by the companies and tested at their laboratories and at the Bureau of Standards. Investigations will be carried on indefinitely as they are important to the industry. Progress: Valuable reports have been presented and two members have published important papers.

Elimination of inclusions from steel (*Henry D. Hibbard, chairman*).—Object: To study solid nonmetallic impurities (sonims) or inclusions in steel, their occurrence, effect on hot-working physical properties, and resistance to corrosion. Progress: No experimental work has been done owing to lack of funds. In May, 1919, the chairman presented a paper to the American Iron and Steel Institute summing up present knowledge.

Substitute deoxidizers (*J. R. Cain, chairman*).—Object: To provide substitutes for manganese or economies in its use. Method: Since one of the most important properties of a deoxidizer is the formation of an oxide slag of sufficient fusibility and fluidity to separate readily from the metal, it was planned to test a series of combinations of oxides. The work was divided into two phases: (1) Laboratory tests of fusibility and viscosity of various synthetic oxide mixtures; (2) manufacture of the most promising mixtures and their try out in steel making. Progress: The first phase is finished and the second is organized. Two steel companies and one commercial laboratory are cooperating, and other companies will supply materials.

Neumann bands (*C. E. Munroe, chairman*).—Object: To determine the relation (if any) between the speed of rupture of a piece of steel and the resulting number of Neumann bands. If a relation exists and is known, it might be possible to determine from the number of bands the violence of the rupturing cause, or at least to distinguish between an explosive and a nonexplosive rupture. Method: To produce explosions of known rates of detonation on plates of steel whose history as to manufacture, heat treatment, and chemical composition is known, and to examine for the presence of Neumann bands and their characteristics. Besides these, samples were supplied by the Army and Navy from plates or projectiles which had been subjected to explosive effects, in some instances to torpedo attack under water.

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High speed tool steels (*J. V. Emmons, chairman.*)—Object: To determine the functions of constituents so that a steel can be developed, together with a proper heat treatment, which will combine highest cutting efficiency with lowest cost. Although the ultimate object is commercial, most of the work involved is fundamental, of a character and magnitude beyond the scope of any industrial laboratory. Progress: A bibliography has been prepared, but little else has been done owing to lack of funds.

Uses of tellurium and selenium (*Victor Lenher, chairman*).—Object: To find new uses for tellurium and selenium since under normal conditions they can be produced in excess of present demand. Method: To approach the three interested companies for subscriptions of $1,000 each, the funds to be used to establish two fellowships for a period of one year, these fellows to work under the direction of Dr. Lenher at the University of Wisconsin. Progress: The committee has determined the amount of tellurium and selenium possible to produce if there were an unlimited market and ascertained all the present uses. The chairman has discovered an unusual solvent, selenium oxychloride. No funds have been contributed.

Uses of cadmium (*Charles H. Fulton, chairman*).—Object: To find new uses for cadmium. Method: To prepare a bibliography, and to make inquiry as to present uses. Progress has been made with the bibliography. No funds are yet available.

Fatigue phenomena of metals (*H. F. Moore, chairman.*)—Object: To extend our knowledge of the nature of fatigue phenomena, to determine the laws relating thereto and in general to reduce this problem to a more rational basis, enabling manufacturers to select materials and sizes so as to withstand alternating stresses. (Fatigue failures occur in steam turbine shafts and rotors, airplane engine crankshafts, hulls of steel ships, axles of railway cars, automobiles and trucks, and many machine parts). Method: To test three typical carbon steels and one chrome nickel steel, with various heat treatments, in the (Farmer) rotating beam, alternating stress machine, and for tensile, compressive and torsional strength, for elasticity and for hardness, including strain gauge measurements. Progress: The Engineering Foundation has made a grant of $15,000 a year for two years beginning November, 1919. Experimental work is being done at the University of Illinois engineering experiment station, which furnishes certain services, laboratory space, and other facilities equivalent to about $6,000 a year. In the summer of 1920 the General Electric Co. agreed to contribute an additional sum of $30,000 for an extension of the work to include 3 and 3½ per cent nickel steel, placing no restriction on the publication of the results. Tests are nearly complete of 0.31 carbon steel sorbitized, a heat treated chrome nickel steel, a 0.50 carbon steel normalized, and a 0.50 carbon steel

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sorbitized. Of three steels to be heat treated the specimens are nearly ready for treatment, a 0.50 carbon troostitic, a 0.90 carbon normalized, and a 0.90 carbon sorbitic steel. The original program will probably be completed in November, 1921. The extension financed by the General Electric Co. will extend beyond that date. Other industries are indicating interest which may develop into further extensions.

New hardness testing machine (*H. L. Whittemore, chairman*).—Object: To develop a machine for hardness testing beyond the capacity of the Brinell and the scleroscope, and to devise better methods. Method: A general study of hardness testing, looking toward improvements in existing methods and apparatus. Progress: A detailed program has been worked out, but lack of funds prevents effective work. A bibliography has been prepared at the expense of the American Society of Mechanical Engineers. Experimental work is in progress at the University of Pittsburgh and at Cooper Union.

Pulverizing (*Galen H. Clevenger, chairman*).—Object: To investigate the fundamental problems connected with pulverizing ores and other materials. Method: To prepare bibliography; assemble unpublished data from researches; prepare a series of critical monographs; then formulate a program for experimental work. For effectiveness a small paid group is to devote full time to the work. A fund of $10,000 per annum is needed. Progress: This committee has been amalgamated with the milling committee of the American Institute of Mining and Metallurgical Engineers. Efforts of the chairman have been confined to securing the necessary subscriptions.

Electrical insulation (*F. B. Jewett, chairman*).—Object: Not to develop new insulating materials nor to solve specific industrial problems, but rather to lay a foundation of fundamental knowledge of the nature of the phenomena, on which solutions of practical problems can be based. Method: The work will be done under the direction of members of the committee at laboratories with which they are associated.

Core losses (*A. E. Kennelly, chairman*).—Object: to reduce the calculation of core losses as well as of eddy current losses in conductors (a similar problem), to a more rational and scientifically exact basis. Progress: This work was started in 1914 by the chairman of the division. The committee awaits the organization of the electrical advisory committee under the American Institute of Electrical Engineers, and financial support from the interested manufacturers. Much special apparatus is available. A paper covering the results of work done was presented to the American Institute of Electrical Engineers by Philip Alger and Rupen Eksergian. Research work is being conducted at the University of Missouri, at Washington University (St. Louis), and at Harvard University.

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Highway advisory board.—Object: To secure cooperation among existing agencies, to coordinate their work into a national research program, and to make results widely available, so as to put road-building on a scientific, engineering, and economical basis. Progress: A highway research conference, November 11, 1920, was attended by representatives from many organizations interested in construction of highways and traffic thereon. An advisory board on highway research was organized, by-laws adopted, and Dean Anson Marston elected chairman. The members of the board are representatives of national organizations and governmental bureaus. Funds for research will be provided through the cooperating agencies; those for administrative expenses of the board are being solicited. Existing committees on highway engineering, economic theory of highway improvement, character and use of road materials, and structural design of roads will function under the advisory board.

Mechanical engineering.—March 24 the council of the American Society of Mechanical Engineers voted to offer the services of the research committee of the society, Arthur M. Greene, jr., chairman, to the engineering division. Problems under investigation are lubrication, bearing metals, heat transfer, cutting action of cutting tools, and permanency and accuracy of cutting tools.

American bureau of welding (C. A. Adams, director).—The American bureau of welding was reorganized as a joint advisory board of the division and the American Welding Society, on welding research and standardization, having members from the American Welding Society, other interested societies, governmental bureaus, and members at large. The bureau fills a need for an unbiased authority. Ten research committees were created: Welding wire specifications, welding of storage tanks, welding conference, electric-arc welding, gas welding, standard tests for welds, training of operators, specifications for steel to be welded, resistance welding and thermit welding. The first three named are actively at work; the last seven are completing their organization.

Welding of storage tanks (J. C. Lincoln, chairman).—Object: To determine the proper procedure for welding storage tanks for light oils. Method: To draw specifications for the construction by electrical welding of a 40-foot diameter tank, a common size constructed by riveting; the Standard Oil Co. has agreed to construct one by welding. Progress: Specifications have been completed for welding by the electric-arc process, and are being extended to include gas and resistance welding.

Welding conference committee (A. Kinsey, chairman).—Object: To draw up a code for the welding of pressure vessels which will have the proper prerequisites for safety without placing unjust restriction on the use of welding. Progress: Through the aid of questionnaires and

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test samples information has been obtained on elements entering into the successful welding of pressure vessels.

Welding wire specifications (C. A. McCune, chairman).—Object: To draw up specifications for the proper limits of the chemical content of welding wire for different purposes. Progress: Specifications have been completed for wire to be used in welding mild steel.

Conclusions.

Opportunities for services of great importance are numberless, but although our committees have accomplished much, progress is slow without sufficient financial support. The substantial advance in welding in one year which would normally have taken five, with a consequent loss of millions of dollars, was due largely to the financial support of the Emergency Fleet Corporation, amounting to over $40,000 for one year. Similarly, progress in the fatigue phenomena research would have been impossible without the early support of the Engineering Foundation, and without this start it is unlikely that the General Electric Co. would have made its appropriation of $30,000. It is easier to secure contributions to a "going" project than to one on paper.

It is hoped that our new scheme of organization, involving the active participation of the societies, will accelerate the movement. The societies can do much through their publications. The advisory committees, which are committees of the societies and the connecting links between them and the division, are expected to take an active part in the campaign of securing the much-needed funds.

DIVISION OF CHEMISTRY AND CHEMICAL TECHNOLOGY.

[F. G. Cottrell, *Chairman.*]

(For present personnel, see Appendix A.)

The work of the division has in the main been a direct continuation of that reported on last year as already under way in its various committees.

The committee on synthetic drugs, Julius Stieglitz, chairman, has furnished valuable information and advice to manufacturers, and upon request has acted in an advisory capacity to the Chemical Foundation which controls most of the important formerly foreign-owned patents.

The committee on colloids, H. N. Holmes, chairman, arranged and carried on lectures at various universities, industrial plants, Government bureaus, and local sections of the American Chemical Society, by W. D. Bancroft, H. N. Holmes, W. A. Patrick, I. N. Kugelmass, and Martin Fisher. As an outcome of its activities a textbook on this subject, by W. D. Bancroft, and laboratory manual, by H. N.

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Holmes, will soon appear, both of which have been badly needed. A detailed classified bibliography on colloid literature is also in course of preparation.

The committee on ceramics, A. V. Bleininger, chairman, secured the maintenance of a fellowship through the generosity of the Corning Glass Works. G. R. Shelton has been appointed to this fellowship and is conducting investigations on the relation between chemical composition and the viscosity and electrical conductivity at high temperatures in the ceramics laboratory of the University of Illinois. Among other problems which this committee has under discussion and on which it is felt that experimental work should be organized, if means can be found available, are (1) coefficients of expansion of borosilicate glazes and their variation with composition, (2) critical study of the analytical melbids required in the determination of the composition of enamels, (3) cataphoretic behavior of clays with reference to the possibilities of using this properly in their purification, (4) factors involved in the corrosion of glass pots, (5) working out of the phase rule diagrams of stems composed of zirconia and the other refractory oxides.

The committee on explosives investigations, Charles E. Munroe, chairman, has continued its labors as a liaison agency between the Ordnance Bureau of the Army and Navy, the Bureau of Mines, and similar groups both at home and abroad. The work of this committee during the current year has continued the problems begun last year. Special attention has been given to the utilization of surplus military explosives, either by (1) developing their adaptability for use as explosives in industry, or (2) by converting them into fertilizer; nitration of corncob cellulose; coefficient of expansion of nitroglycerin; coloring matter for special shells; water storage for explosives; premature explosion of nitroglycerin in oil-well shooting; development of modified T. N. T.; and catalytic nitrations.

The committee has continued to act as an intermediary in the negotiating and carrying out of cooperative agreements between the Bureau of Mines and the College of Agriculture of the University of Wisconsin, the Bureau of Mines and the Federal Reserve Board, the Bureau of Mines and the E. I. du Pont de Nemours Co., and the Ordnance Department, United States Army, with the Geo. Washington University. The committee has also served as a channel of communication and of interchange of publications and documents between various divisions of our Government and officials and specialists in England, France, Italy, Canada, Australia, India, and Scandinavian countries. As a result of the activities of this committee seven papers have been published during the year and five more are now in press or ready for publication.

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The committee on sewage disposal, Edward Bartow, chairman, and the committee on chemical journals, A. B. Lamb, chairman, have made no report as yet but have been continued.

At the annual meeting held on May 7 in Washington the following new committees were created: (1) Pharmaceutical research, John M. Frances, chairman; (2) methods of organic analyses, C. Derick, chairman; (3) contact catalysis, W. D. Bancroft, chairman.

National Research fellowships have been awarded in chemistry to the following persons during the current year:

Arthur F. Benton, "A study of the mechanism of catalytic action in the synthesis of ammonia." Princeton University.

F. Russell Bichowsky, "Verification of the third law of thermodynamics." University of California.

Emmett K. Carver, "A study of the absorption of vapors on glass and quartz at various pressures and temperatures." Harvard University.

Edwin J. Cohn, "The chemistry of systems containing protein." Harvard Medical School.

Roscoe G. Dickinson, "Factors influencing the intensity of reflection of X rays from crystals." California Institute of Technology.

Rolla N. Harger, "Mild organic oxidations." Yale University.

Morris Kharasch, "Mercuric organic derivatives." University of Chicago.

Axel R. Olson, "Study of position and properties of odd electrons in molecules containing an odd number." University of California.

Henry C. Parker, "A redetermination of the absolute value for the specific conductance of certain standard solutions." Clark University.

Worth H. Rodebush, "Study of specific heats and other properties of substances at low temperatures." University of California.

Warren C. Vosburgh, "Catalysis in homogeneous systems with special reference to the catalytic activity of the hydrogen ion in the hydrolysis of sucrose." Columbia University.

C. L. Parsons, acting as delegate for this division and the council, attended the meeting of the International Chemical Union held during June in Rome.

(With regard to progress in the matter of publication of critical tables of physical and chemical constants, see report of division of research extension.)

In his report at the annual meeting, W. D. Bancroft, as retiring chairman, emphasized the importance of stimulating work, particularly in the borderland between different sciences and in fields in which they overlapped, making vigorous and effective cooperation necessary between the personnel in the different subjects. He discussed as illustrative and pertinent examples of such problems (1) baking, (2) turpentine production, (3) protoplasm as a colloid, (4) war gases, (5) special sugars, (6) normal body weight, (7) structural colors, (8) sedimentary rocks, (9) clay, (10) pressure phenomena inside the earth, (11) thunderstorms, (12) surface colors, (13) Brownian movements, (14) absorption of gases, (15) criteria of purity, (16)

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quicksands, (17) metallic luster, (18) educational tests. In concluding his report Dr. Bancroft states:

> This list of problems includes those which happen to appeal to me personally. I shall continue to be interested in them after I retire as chairman, and I shall do my best to push as many as possible of them on to solution. The next chairman will be interested in other problems, and he will continue to push those after his term has expired. By the time this has gone on for five years or so, we shall have a lot of very important problems under way, and some of them will be yielding results. After that everything will be plain sailing and the division of chemistry and chemical technology will justify its existence many times over. At present we are unfortunately long on promises and short on results, but I have confidence that that will not continue to be the case.

The present chairman officially took office on July 1, 1920, but with the understanding that only a small portion of his time could be devoted to the work of the division until a successor should be found to relieve him of his position then as Director of the United States Bureau of Mines. It was hoped at the time that this could be done within a couple of months, but it was actually December 31 before his resignation from the latter position was accepted, so that full-time service only commences as the period of the present report closes.

DIVISION OF GEOLOGY AND GEOGRAPHY.

[EDWARD B. MATHEWS, *Chairman*]

(For present personnel, see Appendix A.)

Organization.—The division consists of representatives nominated by the Geological Society of America (6), Association of American Geographers (3), American Paleontological Society (1), representative of the Government division (1), members at large (9). In addition many geologists not members of the division are serving on committees dealing with special problems.

The division acts through a chairman, devoting one-third of his time, and an executive secretary, Homer P. Little, devoting all of his time to the work of the office.

Geological work depends largely on the expenditures and activities of Federal and State services and needs encouragement of scientific enthusiasm among professional workers drawn from scientific work by inconsequential routine or the high rewards of commercialized science.

Geographical research is largely individual and avocational, covering a wide field of diversified subjects with few workers and needs coordination and promotion. The diversity of subject matter and type of assistance has been recognized, but their combination in one division is necessary.

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WORK OF COMMITTEES.

Committee on sedimentation (*T. Wayland Vaughan, chairman*).—This committee has been very active in stimulating increased study of the problems of sedimentation, and a report of its work was made to the Geological Society of America at its Chicago meeting. It is working under a number of subcommittees investigating the researches on the subject now under way or proposed in the various universities of the country by the State geological surveys and other agencies. Papers were also prepared regarding the physical and chemical researches now in progress, and arrangements are under way for the preparation and publication of a treatise on the whole subject of sedimentation. This committee has coordinated the scattered workers and is accumulating information as to facts available and problems necessary for solution.

Committee on geography (*N. M. Fenneman, chairman*).—This committee has been organized to consider the best methods for development of the geographical sciences in America. The opportunities for instruction are inadequate, and plans are being made for outlining an appropriate curriculum to draw men into geographical research and to train them for their work. This is a large and complex problem reaching out into the borderland of economics, history, and the other physical sciences, and the committee has not filed its report. It has under its supervision the preparation for publication of geographical data accumulated in preparation for the peace conference.

Committee on Pacific exploration (*William M. Davis, chairman*).—This committee, originating as a committee of the National Academy, has now been discontinued, its work being absorbed by the recently organized committee on Pacific investigations.

Committee on paleobotany (*David White, chairman*).—This committee reports little activity during the present year, but it may be recalled that it was the instrument in cooperation with other agencies for securing funds permitting a well-known student of diatoms to devote his whole time to his chosen field with an assistant to carry on his highly specialized work.

Committee on seismology (*Harry Fielding Reid, chairman*).—Several projects offered to the division have been studied by this committee and the work amalgamated into a well-digested proposal for investigation of seismological conditions, particularly in the active region along the Pacific coast. Funds have not yet been secured for this worthy project, but there is a strong probability that a start may be made in this field during the coming year.

Other committees.—Other committees of the division dealing with financial resources, the establishment of fellowships, and the preparation of data useful in geology and geography are not yet ready to report.

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The division force has been engaged in an intensive study of the present conditions of the sciences of geology and geography in the United States. In this work, a personnel list of living contributors to these sciences has been prepared with special reference to the scientific training of the individuals listed and the publications issued by them during the last decade. In this study, the facts from the files of the research information service have been supplemented by an examination of bibliographies, catalogues, membership lists of professional societies, and visits to a number of the leading geological laboratories. This survey gives a solid body of facts on which to base proposals for the promotion of research in these sciences.

The chairman of the division representing the council has been active in the establishment of the United States Board of Surveys and Maps which unites the map-making agencies of the Government for the purpose of eliminating duplication and increasing the efficiency and usefulness of their work. As resident representative of the widely scattered organizations interested in making or using maps, the chairman has served as chairman of the advisory council to this board.

Various projects looking to investigations of specific problems through the cooperation of various State geological surveys or other active agencies have been promoted or are now under way. These include a study of sedimentation in Chesapeake Bay by the Bureau of Fisheries, United States Geological Survey, and the Maryland Geological Survey; a cooperative study of the crystalline rocks of Pennsylvania and Maryland, by the local and Federal surveys; prospective cooperative studies by three of the surveys of the Middle West, and the interchange of experts between different State organizations.

The division has been able to adjust misunderstandings between individual investigators and official organizations which, if left unsettled, would have involved a loss of money already invested and the results of individual effort. Arrangements have been made to supply funds to defray expenses for immediate investigation of earthquake shocks in order that critical details may not be lost during time required to gather funds.

Numerous projects proposed by various investigators have been appraised and their authors put in touch with the leading authorities in their respective lines. In some cases information regarding recent literature has been supplied to men lacking library facilities and exchanges of specimens for comparative study have been arranged.

Other activities are in their formative stage, and their enumeration belongs more properly in later reports.

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DIVISION OF BIOLOGY AND AGRICULTURE.

[C E. McCLUNG, *Chairman.*]

(For present personnel see Appendix A.)

The report from the division for the year 1919 presented its efforts to organize biological and agricultural agencies under peace-time conditions and, therefore, it contained little in the way of accomplishment. An account of the activities for 1920 gratifyingly will include more of accomplishment and not so much of organization. It now appears that early plans were well laid and may be continued with but slight modification. The operations of these plans will be indicated in the consideration of various topics.

When making such a review as this, it is natural to lay stress upon material accomplishments, but of greater significance is the more intangible achievement of bringing the constructive forces of our national organizations into operation and into relation with those of more or less related groups. Essential for this is a spirit of sympathy and understanding between individuals and groups of individuals, resulting most freely from personal contacts. In this respect the division has been very fortunate, and as its most important achievement may be set down the development within the biological and agricultural forces in our national societies of a high degree of solidarity.

As a most effective means toward this end have been the meetings held in the council rooms by the various committees on cooperation chosen by the societies represented in the division. Such meetings by committees from the American Society of Agronomy, the Society of American Foresters, the American Society for Horticultural Science, and the American Phytopathological Society, and by committees on food and nutrition and on fertilizers, have been financed through the division. There was also provided a meeting of a representative group to organize the Second International Eugenics Congress in New York this year. Similarly, the division has brought about important conferences between representatives of institutions and societies interested in tropical research. With the assistance of the division of research extension it has brought together representatives from the American Association of Economic Entomologists and the American Phytopathological Society and from commercial organizations to promote a better understanding in relation to problems of infestations and diseases of plants. In addition to these conferences between direct representatives of societies the division has fostered the spirit of sympathetic cooperation in groups of investigators concerned with problems of food and nutrition and fertilizers. In many other ways, less formal and marked, efforts have been made to promote and encourage the get-together spirit of our workers.

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The efforts of the division can perhaps best be presented under the various subjects represented.

Agronomy.—A conference was held on March 20 by the committee on cooperation, at which plans were laid for a survey of agronomic research and for possible coordination of existing projects. The promotion of regional conferences was also considered. The committee on fertilizers of the war organization was continued and at a meeting held February 7 it was decided to undertake the compilation and publication of a series of monographs on fertilizers. One of these is now rather definitely planned.

Bacteriology.—Informal consideration has been given to problems of publication and to the establishment of an institute of bacteriology. The continuance of an existing museum of living bacteria has received attention in cooperation with the division of medical sciences. An investigation into contamination of food products by microorganisms recommended by the Society of American Bacteriologists, financed by the Glass Containers Association of America, and carried on at the Geneva (N. Y.) Agricultural Experiment Station, was promoted and is administered by the division.

Botany.—The outstanding effort here has been to aid in publication matters. Failing to secure outside support for Botanical Abstracts, the council made a contribution to carry on this publication until definite support could be secured. A war-time committee on the salt requirements of cultivated plants was continued and has been reorganized as a subcommittee of the fertilizer committee. A comprehensive cooperative investigation has thus been continued and will be extended. Here also the council has been obliged to draw on its small funds to support this study. The project for a study of American diatoms recommended to the Carnegie Institution and supported by it is under way and eventually a publication will be prepared giving our present knowledge of the subject.

From the American Phytopathological Society have come recommendations for the establishment of an institute for the intensive study of plant diseases and for a more limited investigation into diseases of tobacco. Both of these are being promoted by the division.

The Ecological Society of America, through its committee, has presented a project for the conservation of natural areas, and there has also been considered a project for conserving pastures and meadows.

The American Association of Economic Entomologists, together with the American Phytopathological Society, has been assisted in the formation of a crop protection institute in which are also included representatives of manufacturers of chemicals and apparatus. This was established with the help of the division of research extension

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and promises to be a most important organization. (See report of division of research extension.)

The Society of American Foresters, through its committee, has prepared an outline of all projects in forestry conducted in this country, and this has been published by the council. It has also laid out two comprehensive cooperative investigations upon reforestation of cut-over lands and upon methods of silviculture, and these have been financed by the Southern Pine Growers' Association. Additional support has come from Government and State sources. This study of a broad ecological problem in the field is now well under way and results will soon be ready for presentation.

The American Genetic Association has presented no project itself but in this field the division has served as an agent to help organize the Second International Eugenics Congress in New York September 22–28, 1921.

On December 4 the committee from the American Society for Horticultural Science held a meeting under the auspices of the division and made plans for the development of a system for conserving and collecting various original species of cultivated fruit plants.

From the American Society of Zoologists no projects have been presented, but the division and council have approved the program of the Marine Biological Laboratory and have sought energetically to secure support for this important cooperative institution. As yet this financial aid has not been secured, but it is unthinkable that it should not eventually come. Another zoological project of great importance is that of the group of publications coming from the Wistar Institute. By means of a well-developed business organization this scientific institute has published without delay of issue or restriction in quantity the zoological and anatomical material coming from our laboratories and has provided a bibliographic service covering the group. This project has been approved by the council, and support has been sought, without success as yet. As an encouragement to that part of the work of the Wistar Institute which concerns the development of our European contacts and the promotion of international cooperation through the free distribution of these journals the council has made a small appropriation.

Assistance to an individual zoologist in carrying forward investigations of high scientific value has been rendered by the division by means of a fellowship secured for a period of three years. This represents an experiment in this method of promoting research.

A number of projects coming less directly from scientific groups have been promoted in the division. One of the largest of these is that formulated by our committee on food and nutrition. This involves a program for an extensive investigation of both animal and human nutrition. Only a part of this has as yet been realized, owing

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to incomplete financial support, but several very important studies, especially upon fundamental problems of animal nutrition, are under way. The support for this has come from industrial concerns interested in foods. The division has also helped in securing support for the long-continued investigation by Dr. Armsby upon animal nutrition.

Through the division there has also been developed an Institute for Research in Tropical America. The members of this are the various institutions and societies interested in tropical problems. This has now taken definite form and has effected an organization of its own. The contact of the council with it now is that of a constituent member. Incidental to this there was held a meeting of a considerable number of men concerned with the present position of scientific research in the Philippines, and after hearing reports from the bureau chiefs in science, forestry, and agriculture, a resolution of commendation and encouragement was given by the division and later by the council through its executive board.

At the request of the American Institute of Baking the division named an advisory board to consider problems arising during the manufacture of bread and to advise and assist in their solution. The first meeting of this board has been held and important problems outlined in the fields of biology, chemistry, and physics.

A service which may frequently be rendered by the council is to investigate and approve scientific projects, either directly or through the advice of societies whose interests are involved. An example of such a condition is an expedition into South America under the direction of Dr. Rusby, to study and collect plants, particularly those of medical value. This project is financed by a pharmaceutical firm, but is found to be entirely free from improper influence or bias. Since it is on such a purely scientific basis it has been approved by the division and been given such help as opportunity afforded.

In another way the division has tried to be helpful in promoting research. The subject of pharmacy is not now represented in the National Research Council. Those best informed in pharmacy realize the present weakness of research in this subject and are zealous in the effort to improve conditions. The chairman of the division addressed the meeting of the American Pharmaceutical Association held in Washington on May 6, and explained the organization and activities of the council and pointed out possible relations between the organizations. By conferences and otherwise he has sought to help pharmaceutical leaders in the development of their plans for promoting pharmaceutical research. It is the hope of these men that when their plans are properly advanced there may be found a place for pharmacy in the National Research Council.

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In addition to the enterprises which have been carried through to completion, or have been definitely advanced in development, there are numerous other efforts to help individual investigators, to promote the plans of groups of investigators, and to carry forward projects within the division that have received attention during the year. In due time they will be more fully presented.

Because the interests of the division approximate so closely those of the Department of Agriculture in many ways, definite efforts have been made by conferences and discussions to present to the large group of scientists in this division of the Government service the opportunities for setting up cooperative relations with their fellow workers in our universities, colleges, and research institutions. Many of these efforts have been very successful, and in time, with the exercise of proper sympathy and understanding, it should be possible to unify more fully the various biological and agricultural groups which, by chance, are segregated in and out of Washington. Necessary to this end is a much better understanding and appreciation of the plans, purposes, and accomplishments of the Washington group by those on the outside. The frequent meetings of committees in the National Capital and the sustained purpose of the chairman of the division and others to make known the extent and quality of the work accomplished through Government agencies has done something to better this understanding, but the efforts should be continued unremittingly.

The contacts of the division with the general divisions of the council and their work will be considered elsewhere.

DIVISION OF MEDICAL SCIENCES.

[GEORGE W. McCOY, *Chairman.*]

(For present personnel see Appendix A.)

During the year this division has concentrated its attention largely on the formulation of a comprehensive program for the study of nephritis. The plan was elaborated by Prof. Henry A. Christian, who was chairman of the division for the greater part of the period. In general the plan contemplated etiological, clinical, pathological, and therapeutic investigations to cover a period of from three to five years and to involve an expenditure of from $250,000 to $300,000. At the close of the year the project remains without financial support.

A survey of the field has been made with respect to investigations on pneumonia. The views of a considerable number of men have been secured and an investigation made of the pneumonia research now being conducted on the country. It appears that during the past two years this problem has been the subject of intensive investigation in a number of laboratories and clinical centers. Most of the

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outstanding problems in connection with the etiology, transmission, and treatment of pneumonia are being adequately covered. Especially worthy of mention are the well-financed researches being carried on by a number of experts supported by funds provided by the Metropolitan Life Insurance Co. of New York. Further study of the subject may show that there are angles which need additional financial support and which the National Research Council might properly sponsor.

In conjunction with the division of anthropology and psychology, the Child Welfare Organization and the Woman's Welfare Organization of Washington have called upon the council for suggestions as to research work which might be carried on by their organizations and for investigations that might be made through other workers utilizing the facilities of the clinics.

Also in connection with the division of anthropology and psychology the subject of nystagmus with special relation to tests for aviators has been the subject of a meeting at which a large number of research workers interested in this field had opportunities of expressing their views. It seems likely that a coordinate research will grow out of this project.

In conjunction with the division of biology and agriculture, there has been consideration given to the application of the American Museum of Natural History, to the application for financial support to enable that institution to continue the maintenance and distribution of the collection of type cultures of bacteria. The council has not been in position to command financial support for this project.

A committee of the division on sources of pure proteins and related substances has reported on the urgent necessity for a trustworthy source of supply of these chemicals and has suggested that financial support therefore be sought by the National Research Council. At the close of the year the matter is before the executive committee of the medical division. The division has continued to furnish opinions and suggestions necessitated by the work of other divisions. The chairman attended the meeting of the American Association for the Advancement of Science in Chicago as a representative of the council. During the year one meeting of the division has been called and one of the executive committee. In view of the limited financial resources it seems unwise to call meetings of either of the bodies unless urgently required, excepting, of course, the annual meeting which is mandatory. During the past three months, the division chairman has been on a part-time basis. This has the advantage of economizing on the council funds, as the chairman being a Government employee served without salary. It is doubtful, however, whether this compensates for the definite loss which the council must incur since it is

32273°—S. Doc. 374, 66-3——6

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obviously impossible for a man actively engaged in governmental administrative work to give to the council the time that the importance of its work makes desirable.

DIVISION OF ANTHROPOLOGY AND PSYCHOLOGY.

[CLARK WISSLER, *Chairman.*]

(For present personnel see Appendix A.)

At the opening of the year the division of anthropology and psychology had barely completed its organization, but proceeded promptly to the formulation of a research program. Sixteen projects were carefully considered, seven of which were approved by the division and recommended to the executive board, as follows:

No. 1. Study of the American people: An anthropological and psychological research on selected racial groups in the United States.

No. 2. Prediction of success of students entering higher institutions.

No. 3. Organized search for research talent among college students.

No. 7. Establishment of a psychological journal to publish a cumulative system of analytical abstracts.

No. 9. Study of intermarriage and race mixture in Hawaii.

No. 10. Archaeological survey of the States of Illinois, Indiana, Iowa, and Missouri.

No. 16. Relation of intelligence and schooling to occupational ability.

Of these, projects 2, 3, 7, and 10 are under way.

Project No. 2. Prediction of success of students entering higher institutions: Under this project is contemplated a comparative research in the relative value of examinations, tests, high-school records, and other data in predicting success or failure of applicants for admission to engineering schools, medical schools, and colleges. The project is a direct outgrowth of the Mann report prepared for the Carnegie Foundation for the Advancement of Teaching. The expenses of the work to date have been met by the institutions contributing the data and by a small appropriation from the division. The research is under the direction of L. L. Thurstone, of the Carnegie Institute of Technology in Pittsburgh, who reports that the necessary data have been gathered among 154 institutions and that progress has been made with the compilations.

Project No. 3. Organized search for research talent among college students: This proposal developed into a joint project with the division of educational relations for the visitation of colleges in the Middle West to confer with the presidents and faculties of these institutions on the encouragement of capable seniors to take up graduate work in higher institutions. G. W. Stewart, professor of physics in the University of Iowa, has volunteered to act as our visiting representative in 1921.

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Project No. 7. Establishment of a psychological journal to publish a cumulative system of analytical abstracts: A special committee was appointed to confer with representatives of the American Psychological Association on the subject of a "Psychological abstract journal." The work of this committee was carried to a definite conclusion, resulting in the establishment of a psychological abstract journal and provision for its financing without direct support from the Research Council.

Project No. 10. State archaeological surveys: A committee was appointed to encourage and assist the several States in the organization of State archaeological surveys similar to the surveys conducted by the States of Ohio, New York, and Wisconsin. The chairman of this committee is R. B. Dixon, of Harvard University. The plan contemplates the coordination of all the agencies within those States, enlisting the cooperation of local students and interested citizens so that an effective appeal may be made to the various States legislatures for special appropriations for these surveys. One thousand dollars was appropriated by the council for the necessary expenses of travel, etc., in the several States. So far the work has been confined to the States of Indiana, Iowa, Illinois, and Missouri. In each of these States, committees are being organized and specific plans formulated for such surveys.

The following special committees of the division have been organized:

1. Child welfare research: This committee is reviewing the research needs of child welfare institutions and is cooperating with the division of medical sciences in the development of a research plan for one such institution in response to a request.

2. Research on accumulated Army data: This committee completed its report and recommendations during the year, formulating a plan for research to utilize all of the psychological data on file in the Office of The Adjutant General. Further recommendations were made for the complete use of the data on file in the Office of the Surgeon General of the Army accumulated in the examination of enlisted and drafted men.

3. National intelligence tests: During the year the work of this committee, formerly a committee of the council at large, was transferred to this division and the committee reappointed by the chairman as a committee of the division. The tests prepared by this committee are published and distributed under contract with a publisher, the profits to revert to the council to be used for the preparation of new tests.

4. Functions of the semicircular canals: The committee appointed to report upon a proposal for nystagmus research recommended the calling of a conference, with the cooperation of the division of

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medical sciences, upon all aspects of that group of problems centering around the morphological structures and functions concerned in orientation, maintenance of equilibrium and perception of movement. Such a conference was held in Chicago and steps taken to organize a committee for the further consideration of these problems.

APPENDIX A.

OFFICERS, MEMBERS, AND COMMITTEES.

OFFICERS AND EXECUTIVE BOARD.

OFFICERS.

Honorary chairman, George E. Hale, director of the Mount Wilson Observatory, Carnegie Institution of Washington, Pasadena, Calif.

Chairman, H. A. Bumstead,[1] professor of physics and director of the Sloane Physical Laboratory, Yale University, New Haven, Conn.

First vice chairman, Charles D. Walcott, secretary of the Smithsonian Institution; president of the National Academy of Sciences, Washington, D. C.

Second vice chairman, Gano Dunn, president of the J. G. White Engineering Corporation, 43 Exchange Place, New York City.

Third vice chairman, R. A. Millikan, professor of physics, University of Chicago Chicago, Ill.

Permanent secretary, Vernon Kellogg, National Research Council, Washington, D.C.

Treasurer, F. L. Ransome, geologist in charge, section of metalliferous deposits, United States Geological Survey; treasurer of the National Academy of Sciences, Washington, D. C.

By reciprocal arrangement with the Engineering Foundation—

Assistant secretary, Alfred D. Flinn, secretary of the Engineering Foundation, 29 West Thirty-ninth Street, New York City.

EXECUTIVE BOARD.

Chairman, H. A. Bumstead.[1]

MEMBERS EX OFFICIO.

Officers of the council.

President of the National Academy of Sciences, Charles D. Walcott, secretary of the Smithsonian Institution, Washington, D. C.

Home secretary of the National Academy of Sciences, C. G. Abbot, director of the Astrophysical Observatory, Smithsonian Institution, Washington, D. C.

President of the American Association for the Advancement of Science, L. O. Howard, chief of the United States Bureau of Entomology, Washington, D. C.

Past chairmen of the National Research Council, George E. Hale, director of the Mount Wilson Observatory, Carnegie Institution of Washington, Pasadena, Calif.; John C. Merriam, president elect of the Carnegie Institution of Washington, Washington, D. C.; James R. Angell, president of the Carnegie Corporation, 522 Fifth Avenue, New York City.

Chairmen of the divisions of general relations.

Chairmen and vice chairmen of the divisions of science and technology.

[1] Deceased.

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MEMBERS AT LARGE.

Edward D. Adams, vice chairman of the Engineering Foundation, 71 Broadway, New York City.

John J. Carty, vice president of the American Telephone & Telegraph Co., 195 Broadway, New York City.

Gano Dunn, president of the J. G. White Engineering Corporation, 43 Exchange Place, New York City.

Van H. Manning, director of the division of research, American Petroleum Institute, 15 West Forty-fourth Street, New York City.

R. A. Millikan, professor of physics, University of Chicago, Chicago, Ill.

A. A. Noyes, director of chemical research, California Institute of Technology, Pasadena, Calif.

Raymond Pearl, professor of biometry and vital statistics, Johns Hopkins University, Baltimore, Md.

M. I. Pupin, professor of electro-mechanics, Columbia University, New York City.

S. W. Stratton, director of the United States Bureau of Standards, Washington, D. C.

C. P. Townsend, patent attorney, Washington, D. C.

William H. Welch, director of the School of Hygiene and Public Health, Johns Hopkins University, Baltimore, Md.

R. S. Woodward, president of the Carnegie Institution of Washington, Washington, D. C.

ADMINISTRATIVE COMMITTEES OF THE COUNCIL.

Committee on budget (joint committee with National Academy of Sciences): Chairman, Charles D. Walcott; H. A. Bumstead,[1] F. L. Ransome.

Committee on building plans: Chairman, George E. Hale; H. A. Bumstead,[1] Gano Dunn, John C. Merriam, R. A. Millikan, A. A. Noyes, Charles D. Walcott, with H. S. Pritchett in an advisory capacity, representing the Carnegie Corporation.

Committee on building stone (with reference to new building): Chairman, Charles D. Walcott; H. A. Bumstead,[1] Vernon Kellogg, John C. Merriam.

Committee on finance: Chairman, H. A. Bumstead;[1] John J. Carty, Gano Dunn, George E. Hale, H. E. Howe, Vernon Kellogg, John C. Merriam.

Committee on organization and budget: Chairman, H. E. Howe; Vernon Kellogg, F. L. Ransome.

Project committee: Chairman, H. A. Bumstead;[1] Vernon Kellogg, F. L. Ransome.

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[1] Deceased.

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32273°—S. Doc. 374, 66-3——7

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F. W. Hodge, Museum of the American Indian, Broadway at One hundred and fifty-fifth Street, New York City.

A. L. Kroeber, curator of anthropology, Museum of Anthropology; professor of anthropology, University of California, Berkeley, Calif.

Berthold Laufer, curator of anthropology, Field Museum of Natural History, Chicago, Ill.

Clark Wissler, curator of anthropology, American Museum of Natural History, New York City.

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The members appointed on this board serve for a period of five years. With them the chairman of the divisions of physical sciences and of chemistry and chemical technology, appointed annually, serve in an ex officio capacity.

MEMBERS OF THE BOARD.

Simon Flexner, chairman, director of research laboratories, Rockefeller Institute for Medical Research, Sixty-sixth Street and Avenue A, New York City.

H. A. Bumstead,[1] professor of physics, and director of the Sloane physical laboratory, Yale University; chairman of the National Research Council, Washington, D. C.

George E. Hale, director of the Mount Wilson Observatory, Carnegie Institution of Washington, Pasadena, Calif.

Elmer P. Kohler, professor of chemistry, Harvard University, Cambridge, Mass.

R. A. Millikan, professor of physics, University of Chicago, Chicago, Ill.

A. A. Noyes, director of chemical research, California Institute of Technology, Pasadena, Calif.

[1] Deceased.

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EX OFFICIO.

F. G. Cottrell, chairman of the division of chemistry and chemical technology, National Research Council; director of the United States Bureau of Mines, Washington, D. C.

Augustus Trowbridge, professor of physics, Princeton University; chairman of the division of physical sciences, National Research Council; executive secretary of the research fellowship board for 1920–21, Washington, D. C.

Fellowships for 1920–21 have been awarded to the following persons, who have demonstrated a high order of ability in research, for the purpose of enabling them to conduct investigations at educational institutions which make adequate provision for research in physics and chemistry:

IN CHEMISTRY.

Arthur F. Benton.
F. Russell Bichowsky.
Emmett K. Carver.
Edwin J. Cohn.
Roscoe G. Dickinson.
Rolla N. Harger.
Morris Kharasch.
Axel R. Olson.
Henry C. Parker.
Worth H. Rodebush
Warren C. Vosburgh

IN PHYSICS.

Ernest F. Barker.
Leonard B. Loeb.
George P. Paine.
Louis T. E. Thompson.

APPENDIX B.

ARTICLES OF ORGANIZATION AS AMENDED UP TO DECEMBER 31, 1920.

PREAMBLE.

The National Academy of Sciences, under the authority conferred upon it by its charter enacted by Congress, and approved by President Lincoln on March 3, 1863, and pursuant to the request expressed in an Executive order made by President Wilson on May 11, 1918, adopts the following articles of organization for the National Research Council, to replace the temporary organization under which it has operated heretofore:

ARTICLE I—PURPOSE.

It shall be the purpose of the National Research Council to promote research in the mathematical, physical, and biological sciences, and in the application of these sciences to engineering, agriculture, medicine, and other useful arts, with the object of increasing knowledge, of strengthening the national defense, and of contributing in other ways to the public welfare, as expressed in the Executive order of May 11, 1918.

ARTICLE II—MEMBERSHIP.

SECTION 1. The membership of the National Research Council shall be chosen with the view of rendering the council an effective federation of the principal research agencies in the United States concerned with the fields of science and technology named in Article I.

SEC. 2. The council shall consist of representatives of national scientific and technical societies; representatives of the Government, as provided in the Executive order; and representatives of other research organizations and other persons whose aid may advance the objects of the council.

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ARTICLE III—DIVISIONS.

SECTION 1. The council shall be organized in divisions of two classes: Divisions dealing with the more general relations and activities of the council, and divisions dealing with special branches of science and technology.

SEC. 2. The initial constitution of the divisions of the council shall be as follows:

Divisions of general relations: Division of Federal relations, division of foreign relations, division of States relations, division of educational relations, division of research extension, and research information service.

Divisions of science and technology: Division of physical sciences, division of engineering, division of chemistry and chemical technology, division of geology and geography, division of medical sciences, division of biology and agriculture, and division of anthropology and psychology.

SEC. 3. The number of divisions and the grouping of subjects in Article III, section 2, may be modified by the executive board of the National Research Council.

SEC. 4. The divisions of general relations shall be organized by the executive board of the National Research Council. (Art. IV, sec. 2.)

SEC. 5. To secure the effective federation of the principal research agencies in the United States, provided for in Article II, a majority of the members of each of the divisions of science and technology shall consist of representatives of scientific and technical societies, who shall be chosen as provided for in Article V, section 2. The other members of the division shall be nominated by the executive committee of the division, approved by the executive board of the National Research Council, and appointed in accordance with Article V, section 4.

SEC. 6. The divisions of the council, with the approval of the executive board, may establish sections and committees, any of which may include members chosen outside the membership of the council.

ARTICLE IV—ADMINISTRATION.

SECTION 1. The affairs of each division shall be administered by a chairman, one or more vice chairmen, and an executive committee, of which the chairman and vice chairmen shall be ex officio members. The officers and the executive committee of each of the divisions of general relations shall be appointed by the executive board for such periods as may be determined by the board, except that the foreign secretary of the National Academy of Sciences shall be ex officio chairman of the division of foreign relations. The officers and executive committee of each of the divisions of science and technology shall be elected by the division at its annual meeting and confirmed by the executive board.

SEC. 2. The affairs of the National Research Council shall be administered by an executive board, of which the officers of the National Research Council, the president and home secretary of the National Academy of Sciences, the president of the American Association for the Advancement of Science. the chairmen and vice chairmen of the divisions of science and technology, and the chairmen of the divisions of general relations shall be members ex officio. In the absence of the chairman of a division the vice chairman or other executive officer shall represent him. The council of the National Academy of Sciences and the executive board of the National Research Council, acting jointly, may nominate additional members, not to exceed 12 in number, who, if not already members of the National Research Council, shall be appointed thereto by the president of the National Academy of Sciences for terms of three years. Upon their retirement, chairmen of the National Research Council shall continue as members of the executive board for two years beyond the period of their appointment. Subject to the approval of the executive board the business of the council may be transacted by an interim committee constituted as defined in the by-laws.

SEC. 3. The officers of the National Research Council shall consist of a chairman, one or more vice chairmen, a permanent secretary, and a treasurer, who shall also serve as members and officers of the executive board of the council.

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SEC. 4. The officers of the National Research Council, excepting the permanent secretary and the treasurer, shall be elected annually by the executive board. The permanent secretary of the council shall be elected by the executive board for a period of one year or more. The treasurer of the National Academy of Sciences shall be ex officio treasurer of the National Research Council.

SEC. 5. The duties of the officers of the council and of the divisions shall be fixed by the executive board.

ARTICLE V—NOMINATIONS AND APPOINTMENTS.

SECTION 1. The Government bureaus, civil and military, to be represented in the division of Federal relations and the scientific and technical societies, to be represented in the divisions of science and technology of the National Research Council, shall be determined by joint action of the council of the National Academy of Sciences and the executive board of the National Research Council.

SEC. 2. Representatives of scientific and technical societies shall be nominated by the societies, at the request of the executive board, and appointed by the president of the National Academy of Sciences to membership in the council and assigned to one of its divisions.

SEC. 3. The representatives of the Government shall be nominated by the president of the National Academy of Sciences after conference with the secretaries of the departments concerned, and the names of those nominated shall be presented to the president of the United States for designation by him for service with the National Research Council.

SEC. 4. Other members of the council shall be nominated by the executive committees of the divisions, approved by the executive board, and appointed by the president of the National Academy of Sciences to membership and assigned to one of the divisions.

SEC. 5. Members of the council shall be appointed for terms of three years, except when appointed to fill unexpired terms.

SEC. 6. The Government representatives shall serve for periods of three years, unless they previously retire from the Government office which they represent, in which case their successors shall be appointed for the unexpired term.

ARTICLE VI—MEETINGS.

SECTION 1. Meetings of the council may be held on call of the executive board.

SEC. 2. The executive board and the divisions shall hold annual meetings, at which, in the case of the divisions of science and technology, officers shall be elected; such other meetings may be called as may be required for the transaction of business. The annual meeting of the executive board shall be held in April in the city of Washington, on a date to be determined as the board may direct.

SEC. 3. Joint meetings of the executive board of the National Research Council and the council of the National Academy of Sciences shall be held from time to time, to consider any matters which, in the judgment of the president of the National Academy, require the attention of both bodies.

ARTICLE VII—PUBLICATIONS AND REPORTS.

SECTION 1. An annual report on the work of the National Research Council shall be presented by the chairman to the National Academy of Sciences for submission to Congress in connection with the annual report of the president of the Academy.

SEC. 2. Other publications of the National Research Council may include papers, bulletins, reports, and memoirs, which may appear in the proceedings or memoirs of the National Academy of Sciences, in the publications of other societies, in scientific and technical journals, or in a separate series of the Research Council.

ARTICLE VIII—AMENDMENTS.

SECTION 1. Power of amendment of these articles of organization shall reside in the council of the National Academy of Sciences.

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ANNUAL REPORT OF THE TREASURER.

[January 1 to December 31, 1920.]

To the PRESIDENT OF THE NATIONAL ACADEMY OF SCIENCES:

I have the honor to submit the following report as treasurer of the Academy for the fiscal and calendar year January 1 to December 31, 1920, and as treasurer of the National Research Council for the same period, although the fiscal year of the Research Council runs from July 1 to June 30. In accordance with the action taken at the autumn meeting of the Academy in November, 1920, the fiscal year of the Academy will hereafter correspond to that of the Research Council. The accounts of these two are herein reported separately, the first part covering the financial transactions of the Academy proper and the second those of the Research Council.

During the year the accounts of the Research Council were completely segregated from those of the Academy proper, so as to prevent duplication and the resultant waste of time and confusion of record. In this connection I wish to acknowledge with appreciation the very faithful and efficient work of Mr. J. H. J. Yule, bursar of the Academy and of the National Research Council.

NATIONAL ACADEMY OF SCIENCES.

The total income of the Academy from gifts, dues, interest on investments and bank deposits, subscriptions and contributions to Proceedings, emergency fund, Proceedings, contributions for the building site, and the William Ellery Hale lectureship was $79,848.58. The miscellaneous disbursements amounted to $70,449.31, and payments on grants from trust funds and for medals amounted to $8,773.45.

The total book value of investments held by the Academy on December 31 was $258,586, yielding interest at that date at the rate of 5.24 per cent on the sum named. The market value of these investments, as nearly as could be determined, on December 31 was $222,541.65, and the interest rate as computed on that sum was 6.20 per cent. Attention is invited to the difference, amounting to $36,044.35, between the book value of the Academy's investments and the market value as shown on pages 114 to 115. This shrinkage of 13.9 per cent is due to the continued abnormal condition of the money market, and does not, it is believed, warrant any concern as to the ultimate value of the security behind bonds of the class owned by the Academy. During the year both the French and the Swiss

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Governments have floated long-term bond issues in this country at 8 per cent interest, and domestic offerings of high-class securities at the same rate have been numerous.

The sum of $2,040 was contributed by 19 members of the Academy during the year for the purpose of furnishing working capital for the publication of the Proceedings of the Academy.

Changes in the investments during the year may be summarized as follows: Loans on real estate aggregating $10,000 were paid. Two real estate notes for a total of $5,000 were renewed for three years at an increased rate of interest. Five bonds of a total face value of $5,000 were called for retirement and redeemed. Twelve additional bonds of the total face value of $10,000 were purchased for $8,890. Bonds of a total face value of $3,200 and a total book value of $3,100 owned by the National Research Council were transferred to the books of that organization.

In accordance with the action of the Academy in November, 1916, the capital of the Marsh fund was increased to $20,000 through the transfer of $500 from income, and the total of this fund is now the full amount authorized by the Academy.

The consolidated investment fund now totals $174,745.50, an increase of $500 having been made by addition to the Marsh fund, and a decrease of $9,400 having been made by the elimination of the building fund, the capital of which was used for part of the purchase price of the building site.

During the year additional contributions in cash amounting to $35,000 were received toward the purchase of a building site for the Academy and the Research Council. These contributions, together with $9,400 capital and $1,050.18 income of the building fund, both of which were transferred to the building site fund, have enabled me to repay entirely the loan of $40,000 made on securities owned by the Academy, mentioned in my last report.

A contribution of $5,000 was received from the Carnegie Corporation of New York, being the first installment on their appropriation for the construction of a building for the Academy and the Research Council, and this contribution was expended for the preparation of preliminary plans for such a building.

TRUST FUNDS OF THE ACADEMY.

The trust funds of the Academy, the income of which is administered for specific purposes, are enumerated below. The capital of certain funds has been increased beyond the amount of the original gift or bequest by the transfer of accumulated income at the request of the donors or by action of the Academy.

Bache fund: Bequest of Alexander Dallas Bache, a member of the Academy, 1870. To aid researches in physical and natural sciences..... $59,000.00

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Watson fund: Bequest of James C. Watson, a member of the Academy, 1874. For the promotion of astronomical science through the award of the Watson gold medal and grants of money in aid of research	$25,000.00
Draper fund: Gift of Mrs. Henry Draper, 1883. In memory of her husband, a former member of the Academy. To found the Henry Draper gold medal, to be awarded for notable investigations in astronomical physics. The balance of income is applied to air research in the same science	10,000.00
Smith fund: Gift of Mrs. J. Lawrence Smith, 1884, in memory of her husband, a former member of the Academy. To found the J. Lawrence Smith gold medal, to be awarded for important investigations of meteoric bodies and to assist, by grants of money, researches concerning such objects	10,000.00
Gibbs fund: Established by gift of Wolcott Gibbs, a member of the Academy, 1892, and increased by a bequest of the late Morris Loeb, 1914. For the promotion of researches in chemistry	5,545.50
Gould fund: Gift of Miss Alice Bache Gould, 1897, in memory of her father, a former member of the Academy. For the promotion of researches in astronomy	20,000.00
Comstock fund: Gift of Gen. Cyrus B. Comstock, a member of the Academy, 1907. To promote researches in electricity, magnetism, or radiant energy through the Comstock prize of money, to be awarded once in 5 years for notable investigations. The fund is to be increased ultimately to $15,000	12,406.02
Marsh fund: Bequest of Othniel Charles Marsh, a member of the Academy, 1909. To promote original research in the natural sciences. To the original bequest of $10,000 the Academy has added interest received from the estate and has authorized the increase of the fund to $20,000 by annual additions from income	20,000.00
Murray fund: A gift from the late Sir John Murray, 1911, to found the Alexander Agassiz gold medal, in honor of a former member and president of the Academy, to be awarded for original contributions to the science of oceanography	6,000.00
Hartley fund: A gift from Mrs. Helen Hartley Jenkins, 1913–14, in memory of her father, Marcellus Hartley, to found the medal of the Academy awarded for eminence in the application of science to the public welfare.	1,200.00
Billings fund: Established by the bequest of Mrs. Mary Anna Palmer Draper (Mrs. Henry Draper) of $25,000, 1915. To support the publication of the proceedings of the Academy or for other purpose, to be determined by the Academy. Three installments	5,000.00
Elliot fund: Gift of Margaret Henderson Elliot to found the Daniel Giraud Elliot gold medal and honorarium for the most meritorious work in zoology or paleontology published in each year	8,000.00
Thompson fund: Gift of Mrs. Mary Clark Thompson, 1919, the income thereof to be applied for a gold medal of appropriate design to be awarded annually by the Academy for the most important services to geology and paleontology; the medal to be known as the Mary Clark Thompson gold medal	10,000.00
In addition to the above-named funds the Academy holds the following: Agassiz fund—Bequest of Alexander Agassiz, a member of the Academy 1910, for the general uses of the Academy	50,000.00
Total	242,151.52

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Statement of assets and liabilities Dec. 31, 1920.

ASSETS.

Items.	Face value.	Book value.	Market value Dec. 31, 1920.
Mortgage notes, secured by first mortgages on real estate	$30,500.00	$30,500.00	$30,500.00
BONDS			
(Bonds purchased during the year are indicated thus: *.)			
American Telephone & Telegraph Co., 30-year, 5 per cent, gold collateral trust, due Dec. 1, 1946; Nos. 4604, 29245, 29246, 41419; 4 at $1,000	4,000.00	3,817.50	3,050.00
Asheville Power & Light Co., first mortgage, 30-year gold, 5 per cent, due Apr. 1, 1942, New York; Nos. 272, 490, 492, 508, 509; 5 at $1,000	5,000.00	4,892.50	3,250.00
Broadway Realty Co., purchase money, first 5 per cent gold, due Sept. 1, 1926; Nos. 50, 796, 963-965, 1068, 1616-1620, *1102, *1139, *1629, *1630; 15 at $1,000	15,000.00	14,930.00	13,575.00
Bush Terminal Buildings Co., first mortgage 50-year sinking fund, 5 per cent, gold, due Apr. 1, 1960; Nos. 1383-1387 and 2805-2809; 10 at $1,000	10,000.00	9,375.00	6,787.50
Chesapeake & Ohio, general mortgage, 4.5 per cent, gold, due New York, Mar. 1, 1992; Nos. 15350-15354; 5 at $1,000	5,000.00	4,600.00	3,725.00
City of Tacoma, Green River special water fund No. 2; 5 per cent, due Oct. 1, 1939; Nos. 1508-1511; 4 at $1,000	4,000.00	4,140.00	3,558.00
Cleveland Electric & Illuminating Co., first mortgage, 5 per cent, gold, due New York, Apr. 1, 1939; Nos. D261-D264; 4 at $500, and Nos. M6060, M6096, M6097, M15094-15098; 8 at $1,000	10,000.00	9,897.50	8,200.00
Commonwealth Electric Co., first 5 per cent, due June 1, 1943; Nos. 2945-2947, 4011; 4 at $1,000	4,000.00	3,800.00	3,040.00
Cosmos Club, 4.5 per cent, due July 1, 1949; Nos. 286-289, 290-294, 296, 297, 299, 301, 303-305, 350; 17 at $1,000	17,000.00	17,000.00	12,750.00
Detroit Edison Co., first and refunding, mortgage, gold, 5 per cent, due Jan. 1, 1940; Nos. 9657-9660; 4 at $1,000, and Nos. D501, D502, D599; 3 at $500	5,500.00	5,005.00	4,180.00
Detroit Edison Co., first mortgage, 30-year gold, 5 per cent, due Jan. 1, 1933; Nos. 557, 2442, 2443, 3024, 3252, 3253, 3639-3641, 8086; 10 at $1,000	10,000.00	10,072.50	8,775.00
Dominion Coal Co. (Ltd.), first mortgage, sinking fund, gold, 5 per cent, due New York, Mar. 1, 1940; Nos. A1037-A1039; 3 at $1,000	3,000.00	2,718.75	2,557.50
Galveston, Harrisburg & San Antonio, Mexican and Pacific Ex., 6 per cent, second guaranteed, reduced to 5 per cent, due Jan. 1, 1931; Nos. 1044, 1048, 1248, 2112-2116; 8 at $1,000	8,000.00	8,030.00	6,200.00
Georgia Ry. & Electric Co., first consolidated mortgage, 5 per cent, sinking fund, gold, due Jan. 1, 1932; Nos. 191, 1061, 1600; 3 at $1,000	3,000.00	2,995.00	2,100.00
Government of the Province of Alberta, 4.5 per cent, 10-year gold debenture, due New York, Dec. 1, 1923; Nos. 1501-1511; 11 at $100, and Nos. 2031, 2032; 2 at $500	2,100.00	2,008.50	1,785.00
Government of the Province of Alberta, 4.5 per cent, 10-year gold debenture, due New York, Feb. 1, 1924; No. 2620; 1 at $500	500.00	480.00	425.00
Government of the Province of Alberta, 5 per cent, 10-year gold debenture, due New York, May 1, 1925; No. 2364; 1 at $1,000, and Nos. 0189B-0193B; 5 at $500	3,500.00	3,373.75	3,109.00
Grand Rapids Gas Light Co., 5 per cent, firstmortgage, gold, due New York, Aug. 1, 1939; Nos. A522, A523, A595, A596; 4 at $1,000	4,000.00	4,020.00	3,200.00
Hydraulic Power Co., of Niagara Falls, 5 per cent, refunding and improvement mortgage, due Oct. 1, 1951; Nos. D457, D458, *D244; 3 at $500	1,500.00	1,320.00	1,237.50

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Statement of assets and liabilities Dec. 31, 1920—Continued.

ASSETS—Continued.

Items.	Face value.	Book value.	Market value Dec. 31, 1920.
BONDS—continued.			
Liberty, third loan, 4¼ per cent gold of 1928; Nos. 8239, at $10,000; Nos. 2643499-2643523; 25 at $100; and Nos. 4070782-4070787; 6 at $50	$12,800.00	$12,800.00	$11,392.00
Liberty, fourth loan, 4¼ per cent, gold, of 1933-1938; Nos. 2566501, 2566502; 2 at $100	200.00	200.00	174.00
Michigan Northern Power Co., first mortgage guaranteed, 5 per cent, due 1941; Nos. 5054, 5057, 5216, *5516, 5567-5571, *6515; 10 at $1,000; and Nos. *4367, *4368; 2 at $500	11,000.00	9,540.00	8,580.00
Milwaukee Electric Ry. & Light Co., 5 per cent general and refunding mortgage, gold, series A, due New York, Dec. 1, 1951; Nos 2068, 2772, 3830, 3840, 3930, 3931, 5222-5224; 9 at $1,000	9,000.00	8,237.50	6,761.25
Minneapolis General Electric Co., 5 per cent 30-year gold mortgage, due New York, Dec. 1, 1934; Nos. 1621, 1622, 1949, 2004, 2572-2575, 7579, 7580; 10 at $1,000	10,000.00	9,880.00	8,400.00
Niagara Falls Power Co., first mortgage, 5 per cent, gold, coupon due Jan 1, 1932; Nos. 5246, 5247, 6583, 8358; 4 at $1,000	4,000.00	4,100.00	3,450.00
Niagara Falls Power Co., first mortgage, 5 per cent, gold, registered, due Jan. 1, 1932; No. R484; 1 at $6,000	6,000.00	5,760.00	5,175.00
Riggs Realty Co., 3-30-year coupon, first 5 per cent, due Washington, D. C., Oct. 1, 1940; Nos. 124, 128, 132, 136, 140, 144; 6 at $1,000	6,000.00	6,195.00	5,520.00
Shawinigan Water & Power Co., 5 per cent consolidated mortgage, 30-year, gold, due Jan. 1, 1934; Nos M0854, M0510, M2894, M2943; 4 at $1,000	4,000.00	3,822.50	3,480.00
Southern Bell Telephone & Telegraph Co., 30-year first mortgage, 5 per cent, sinking fund, gold, due Jan. 1, 1941; Nos. M9739, M11576-M11579, M13965, M15568-M15570; 9 at $1,000	9,000.00	8,942.50	7,267.50
*Swiss Government, 8 per cent, due July 1, 1940; temporary certificate, No. *M10264; 1 at $1,000	1,000.00	1,000.00	1,020.00
Trinity Buildings Corporation, first mortgage, gold, 5½ per cent, due 1939; Nos. M5229-M5243; 15 at $1,000; and Nos. D697-D706; 10 at $500	20,000.00	19,900.00	17,200.00
Two Rector Street Corporation, first mortgage, 15-year, sinking fund, gold loan, 6 per cent, due Apr. 1, 1935; No. *M300; 1 at $1,000; No. *D152; 1 at $500	1,500.00	1,500.00	1,305.00
Union Electric Light & Power Co., of St. Louis, 5 per cent first mortgage, 30-year, gold, due New York, Sept. 1 1932; Nos. 1352, 4169, 8601, 3821; 4 at $1,000	4,000.00	3,782.50	3,020.00
United Kingdom of Great Britain and Ireland, 10-year, 5½ per cent, due Aug. 1, 1929; Nos. M138584-M138599; 16 at $1,000	16,000.00	15,400.00	13,800.00
Vicksburg, Shreveport & Pacific R. R. Co., prior-lien mortgage at 6 per cent, gold, renewed at 5 per cent, due Nov. 1, 1915, extended to Nov. 1, 1940; Nos. 561, 661, 794, 982, 1323; 5 at $1,000	5,000.00	5,050.60	4,000.00
Total	265,100.00	258,586.00	222,541.65

SUMMARY.

Book value of mortgage notes as above	$30,000.00	
Book value of bonds as above	228,086.00	
		$258,586.00
Bank balance Dec. 31, 1920		13,656.61
Total		272,242.61

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Statement of assets and liabilities Dec. 31, 1920—Continued.

LIABILITIES.

	Income.	Capital.		Income.	Capital.
General fund, uninvested	$1,128.30		Hartley fund:		
Agassiz fund, invested		$50,000.00	Invested		$1,200.00
Bache fund:			Uninvested	$166.94	
Invested		59,000.00	Marsh fund:		
Uninvested	1,597.96		Invested	150.00	20,000.00
Billings fund:			Uninvested	1,457.38	
Invested	50.00	5 000.00	Murray fund:		
Uninvested			Invested	400.00	6,000.00
Building site:			Uninvested	611.76	
Invested	2,240.00		Proceedings:		
Uninvested	248.61		Invested		
Comstock fund:			Uninvested		
Invested	500.00	12,265.00	Emergency fund, Proceedings, uninvested	477.54	
Uninvested	1,287.77	141.02	Smith fund:		
Consolidated fund, uninvested	1,441.00		Invested	2,560.00	10,000.00
Draper fund:			Uninvested	1,413.76	
Invested	917.50	10,000.00	Thompson fund:		
Uninvested	762.00		Invested		10.000.00
Elliot fund:			Uninvested	173.93	
Invested	300.00	8,000.00	Watson fund:		
Uninvested	847.89		Invested	1,780.00	24,976.25
Gibbs fund:			Uninvested	918.85	23.75
Invested	500.00	5,545.50			
Uninvested	72.15		Grand total	30,091.09	242,151.52
Gould fund:					
Invested	7,010.00	19,992.50	Consolidated investment fund:		
Uninvested	837.16	7.50	Invested		174,744.75
Hale lectureship:			Uninvested	1,441.00	.75
Invested	200.00				
Uninvested	40.59		Total	1,441.00	147,745.50

Condensed statement of receipts and expenditures, Jan. 1 to Dec. 31, 1920.

RECEIPTS.

Balance Jan. 1, 1920, as per last report		$13,030.79
Cash receipts:		
Proceedings—		
Annual dues	$980.00	
Subscriptions	1,604.21	
Reprints and separates	763.39	
National Research Council—		
Subscriptions	895.00	
Space	1,858.50	
Reprints	276.17	
		$6,377.27
Special contributions, Proceedings		2,040.00
General fund—		
Interest on bank deposits		306.57
Contributions to building site		35,000.00
Interest on investment, building site		753.18

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Cash receipts—Continued.		
Contribution for building plans	$5,000.00	
William Ellery Hale lectureship	500.00	
William Ellery Hale fund for International Research Council	350.00	
Total income from investments	14,560.52	
Bonds called in and paid	4,946.25	
Mortgage notes paid	10,000.00	
Profit on sale of bonds	14.79	
		$79,848.58
Book transfers:		
Income transfers	3,020.00	
Distribution of consolidated	9,037.25	
		12,057.25
Total		104,936.62

EXPENDITURES.

Book transfers:		
Income transfers	$3,020.00	
Distribution of consolidated	9,037.25	
		12,057.25
Cash expenditures:		
Transferred to National Research Council—uninvested cash, Dec. 31, 1919	1,301.73	
Architect's fee, preliminary plans for building	5,000.00	
International Research Council	349.75	
Investment of capital	8,890.00	
Accrued interest on bonds purchased	174.55	
Adjustment on sale of bonds	162.50	
Repaid loan on collateral, building site	40,000.00	
Interest on loan on collateral, building site	273.91	
Cost of plats, blue prints, etc	41.72	
Payments from trust and other funds:		
Bache fund—		
J. C. Jensen, grant	$250.00	
Asa A. Schaefer, grant	450.00	
Carl H. Eigenmann, grant	500.00	
William Bowie, grant	150.00	
Henry G. Barbour, grant	600.00	
T. H. Goodspeed, grant	335.00	
C. H. Warren, grant	500.00	
W. Lindgren, grant	200.00	
Miscellaneous expenses	1.00	
		2,986.00
Draper fund—		
S. A. Mitchell, grant	400.00	
Joel Stebbins, grant	300.00	
Edwin B. Frost, grant	175.00	
Antonio Abetti, grant	500.00	
Medals	228.05	
		1,603.05
Gibbs fund—		
W. D. Harkins, grant	500.00	
R. L. Datta, grant	100.00	
		600.00

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Payments from trust and other funds—Continued.			
Gould fund, Astronomical Journal		$600.00	
Hale lectureship, honorariums		500.00	
Hartley fund, medal		36.64	
Murray fund, medals		446.69	
Thompson fund—			
Preliminary expenses	$51.07		
Design for medal	200.00		
Sketches for medal	500.00		
Model for medal	500.00		
		1,251.07	
Watson fund—			
John A. Miller, grant	500.00		
J. A. Parkhurst, grant	250.00		
		750.00	
Proceedings:			
Salary, managing editor		750.00	
Printing and distributing		7,584.19	
Expenses, Boston office		255.00	
Expenses, Washington office		222.66	
			$8,811.85
General fund:			
Salary, assistant secretary		800.00	
Home secretary's office		1,303.01	
Treasurer's office		373.50	
Memoirs, printing, etc		1,773.23	
Meeting—			
Annual		941.64	
Autumn		204.40	
Election of members		47.52	
			5,443.30
			91,280.01
Balance Dec. 31, 1920			13,656.61
Total			104,936.62

Accounts with individual funds Jan. 1 to Dec. 31, 1920.

	General fund.		Agassiz fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1920:				
Cash	$575.67			
Invested	3,020.00			$50,000.00
Receipts:				
Interest on deposits	306.57			
Interest on investments	2,669.36			
Total	6,571.60			50,000.00
Disbursements:				
General expenses	5,443.30			
Balance Dec. 31, 1920:				
Cash	1,128.30			
Invested				50,000.00
Total	6,571.60			50,000.00

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Accounts with individual funds Jan. 1 to Dec. 31, 1920—Continued.

	Bache fund.		Billings fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1920:				
Cash	$1,685.83		$70.84	
Invested		$59,000.00	50.00	$5,000.00
Receipts:				
Interest on investments	2,898.13		237.58	
Total	4,583.96	59,000.00	358.42	5,000.00
Disbursements:				
Grants and medals	2,986.00			
Transfer to proceedings			308.42	
Balance Dec. 31, 1920:				
Cash	1,597.96			
Invested		59,000.00	50.00	5,000.00
Total	4,583.96	59,000.00	358.42	5,000.00

	Building construction.		Building fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1920:				
Cash			$690.36	
Invested			200.00	$9,400.00
Receipts:				
Carnegie Corporation of New York	$5,000.00			
Interest on investments			159.82	
Transfer from consolidated capital to building-fund income			9,400.00	
Total	5,000.00		10,450.18	9,400.00
Disbursements:				
Architect's fee, preliminary plans	5,000.00			
Transfer from capital to income				9,400.00
Transfer to building site income			10,450.18	
Total	5,000.00		10,450.18	9,400.00

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Accounts with individual funds Jan. 1 to Dec. 31, 1920—Continued.

	Building site.		Comstock fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1920:				
Cash			$903.77	$141.02
Invested			500.00	12,265.00
Receipts:				
Subscriptions	$35,000.00			
Transfer from building fund	10,450.18			
Interest on investments	753.18		384.00	
Total	46,203.36		1,787.77	12,406.02
Disbursements:				
Repaid loan, National Academy	3,378.63			
Repaid loan on collateral	40,000.00			
Interest on loan	273.91			
Accrued interest on bonds purchased	20.49			
Plats, blue prints, etc	41.72			
Balance Dec. 31, 1920:				
Cash	248.61		1,287.77	141.02
Invested	2,240.00		500.00	12,265.00
Total	46,203.36		1,787.77	12,406.02

	Consolidated fund.		Draper fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1920:				
Cash	$1,568.79	$894.50	$381.91	
Invested		182,751.00	1,952.50	$10,000.00
Receipts:				
Interest on investments	8,938.61		948.14	
Cash transfer (Marsh)		500.00		
Profit on sale of bonds	14.79			
Total	10,522.19	184,145.50	3,282.55	10,000.00
Disbursements:				
Transfer from consolidated capital to building-fund income		9,400.00		
Accrued interest on bonds purchased	43.94			
Distribution of consolidated	9,037.25			
Grants and medals			1,603.05	
Balance Dec 31, 1920:				
Cash	1,441.00	.75	762.00	
Invested		174,744.75	917.50	10,000.00
Total	10,522.19	184,145.50	3,282.55	10,000.00

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Accounts with individual funds Jan. 1 to Dec. 31, 1920—Continued.

	Elliot fund.		Gibbs fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1920:				
Cash	$419.66		$352.73	
Invested	300.00	$8,000.00	500.00	$5,545.50
Receipts:				
Interest on investments	428.23		319.42	
Total	1,147.89	8,000.00	1,172.15	5,545.50
Disbursements:				
Grants			600.00	
Balance Dec. 31, 1920:				
Cash	847.89		72.15	
Invested	300.00	8,000.00	500.00	5,545.50
Total	1,147.89	8,000.00	1,172.15	5,545.50

	Gould fund.		Hale lectureship.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1. 1920:				
Cash	$1,205.39	$7.50	$27.58	
Invested	6,250.00	19,992.50	200.00	
Receipts:				
Interest on investments	1,114.65		12.76	
Contributions to Hale lectureship			850.00	
Total	8,570.04	20,000.00	1,090.34	
Disbursements:				
Astronomical Journal	600.00			
Loss on sale of bonds	90.00			
Accrued interest on bonds purchased	32.88			
Honorariums—Hale lectureship			500.00	
Contributions to international research council			349.75	
Balance Dec. 31, 1920:				
Cash	837.16	7.50	40.59	
Invested	7,010.00	19,992.50	200.00	
Total	8,570.04	20,000.00	1,090.34	

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Accounts with individual funds Jan. 1 to Dec. 31, 1920—Continued.

	Hartley fund.		Marsh fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1920:				
Cash	$142.13		$944.05	
Invested		$1,200.00	150.00	$19,500.00
Receipts:				
Interest on investments	61.45		1,013.33	
Transfer income to capital				500.00
Total	203.58	1,200.00	2,107.38	20,000.00
Disbursements:				
Medal	36.64			
Transfer income to capital			500.00	
Balance Dec. 31, 1920:				
Cash	166.94		1,457.38	
Invested		1,200.00	150.00	20,000.00
Total	203.58	1,200.00	2,107.38	20,000.00

	Murray fund.		Smith fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1920:				
Cash	$726.86		$1,289.21	
Invested	400.00	$6,000.00	2,032.50	$10,000.00
Receipts:				
Interest on investments	331.59		724.23	
Total	1,458.45	6,000.00	4,045.94	10,000.00
Disbursements:				
Medals	446.69			
Loss on sale of bonds			22.50	
Accrued interest on bonds purchased			49.68	
Balance Dec. 31, 1920:				
Cash	611.76		1,413.76	
Invested	400.00	6,000.00	2,560.00	10,000.00
Total	1,458.45	6,000.00	4,045.94	10,000.00

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Accounts with individual funds Jan. 1 to Dec. 31, 1920—Continued.

	Proceedings.		Emergency fund proceedings.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1920:				
Cash	$563.70			
Invested				
Receipts:				
Annual dues	980.00			
Subscriptions	1,694.21			
Reprints and separates	763.39			
Transfer from Billings fund	308.42			
From National Research Council—				
Subscriptions $895.00				
Space 1,858.50				
Reprints 276.17				
	3,029.67			
Temporary loan from emergency fund proceedings	1,562.46			
Special contributions			$2,040.00	
Total	8,811.85		2,040.00	
Disbursements:				
Temporary loan to proceedings			1,562.46	
Salary, managing editor	750.00			
Printing and distributing	7,584.19			
Expenses, Boston office	255.00			
Expenses, Washington office	222.66			
Balance Dec. 31, 1920:				
Cash			477.54	
Invested				
Total	8,811.85		2,040.00	

	Thompson fund.		Watson fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1920:				
Cash	$1,000.00		$992.44	$523.75
Invested		$10,000.00	1,000.00	24,476.25
Receipts:				
Interest on investments	425.00		1,533.97	
Total	1,425.00	10,000.00	3,526.41	25,000.00
Disbursements:				
Sketches, design, and model for medal	1,200.00			
Preliminary expenses	51.07			
Loss on sale of bonds			50.00	
Grants			750.00	
Accrued interest on bonds purchased			27.50	
Balance Dec. 31, 1920:				
Cash	173.93		918.85	23.75
Invested		10,000.00	1,780.06	24,976.25
Total	1,425.00	10,000.00	3,526.41	25,000.00

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NATIONAL RESEARCH COUNCIL.

The activities of the National Research Council during the calendar year 1920 were supported by funds derived from various sources. The following list gives the main sources of these funds:

(1) For general maintenance expenses of the National Research Council, $170,000 was received from the Carnegie Corporation of New York, $25,000 from the American Telephone & Telegraph Co., and $12,000 from the Commonwealth fund.

(2) From the Rockefeller Foundation the following amounts were received and disbursed:

For the division of medical sciences the sum of $111.56 was received and the sum of $7,437.38 was disbursed.

For the division of physical sciences the sum of $12,775.06 was received and the sum of $16,775.06 was disbursed.

The sum of $29,258.16 was received for national research fellowships and the sum of $36,716.05 was disbursed.

(3) From the General Education Board contributions were made as follows:

For the mental rating of school children the sum of $3,157.15 was received and the sum of $6,950.63 was disbursed.

For special work carried on by the division of educational relations, the sum of $7,500 was received and the sum of $4,813.15 was disbursed.

(4) The sum of $599.29 was contributed by the Government through the Council of National Defense for governmental activities of the National Research Council prior to June 30, 1919.

The sum of $336.50 was received from the Government through the Ordnance Bureau of the War Department to reimburse the National Research Council for expenditures for experimental work on a new type of gun.

(5) Other contributions included:

The sum of $5,000 from E. I. du Pont de Nemours & Co., and the sum of $2,500 from the General Motors Corporation for special work of the research information service.

The sum of $5,911.05 from the William Ellery Hale fund and others for the division of foreign relations.

The sum of $800 from the Corning Glass Works for the support of a research fellowship in ceramics at the University of Illinois.

The sum of $1,750 from the Southern Pine Association (part payment on pledge of $10,000) for the committee on forestr[illegible].

The sum of $1,500 from Julius Rosenwald for the support of a fellowship.

From various sources: For industrial personnel conference, $1,000; for food products investigation, $1,000; for food and nutrition com-

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mittee, $3,275; for the trustees for the publication of critical tables of physical and chemical constants, $4,890; for international auxiliary language, $1,300.

Receipts and disbursements of the National Research Council, Jan. 1, 1920, to Dec. 31, 1920.

RECEIPTS.

Balance reported Jan. 1, 1920		$31,147.82
On deposit with National Academy of Sciences Jan. 1, 1920, unappropriated fund special:		
Invested	$1,865.00	
Uninvested	1,301.73	
		3,166.73
Total		34,314.55
Rockefeller Foundation:		
Medical sciences (R. F. 2369)	111.56	
Physical sciences (R. F. 2432)	12,775,06	
National research fellowships (R. F. 2431)	29,258.16	
General Education Board:		
Mental rating of school children	3,157.15	
Division of educational relations	7,500.00	
Commonwealth fund	12,000.00	
Carnegie Corporation of New York	170,000.00	
American Telephone & Telegraph Co	25,000.00	
Government:		
National Research Council	599.29	
Rice gun	336.50	
Special contributions, research information service:		
E. I. du Pont de Nemours & Co	5,000.00	
General Motors Corporation	2,500.00	
Division of foreign relations:		
William Ellery Hale fund and others	5,911.05	
Research fellowship in ceramics, supported by Corning Glass Works	800.00	
Southern Pine Association, for committee on forestry	1,750.00	
Julius Rosenwald for support of fellowship	1,500.00	
Industrial personnel conference	1,000.00	
Food products investigation fund	1,000.00	
Food and nutrition committee	3,275.00	
Trustees for the publication of physical and chemical constants.	4,890.00	
International auxiliary language	1,300.00	
Unappropriated fund, special interest on investments	134.17	
Publication of forest research calendar	100.00	
Sale of United States Treasury certificates	40,564.77	
Interest received on United States Treasury certificates	477.10	
Reimbursements	139.43	
Miscellaneous receipts	2,316.94	
		333,396.18
Total		367,710.73

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DISBURSEMENTS.

Divisions.	
I. Federal relations, general maintenance, 1921	None.
II. Foreign relations:	
General maintenance, 1920	$411.05
General maintenance, 1921	3,895.12
III. States relations:	
General maintenance, 1920	541.38
General maintenance, 1921	59.59
IV. Educational relations:	
General maintenance, 1920	1,067.08
General maintenance, 1921	77.86
General Education Board	4,813.15
V. Research extension:	
General maintenance, 1920	990.72
General maintenance, 1921	910.20
VI. Research information service:	
General maintenance, 1920	2,999.28
General maintenance, 1921	434.40
Contingent expenses, 1921	
Equipment, 1921	
National Academy proceedings and subscriptions, 1921	747.52
General Education Board, mental rating of school children	6,950.63
VII. Physical sciences:	
General maintenance, 1920	1,141.09
General maintenance, 1921	199.67
Scientific Instrument Journal, 1921	
(R. F. 2432) traveling expenses, Rockefeller Foundation	16,775.06
VIII. Engineering:	
General maintenance, 1920	1,222.92
General maintenance, 1921	468.60
Office expenses—	
1920	317.56
1921	229.73
Projects, 1921	142.43
Industrial personnel conference	474.96
IX. Chemistry and chemical technology:	
General maintenance, 1920	864.59
General maintenance, 1921	127.88
International auxiliary language	1,216.00
Research fellowships (R. F. 2431)	36,716.05
Research fellowship in ceramics, supported by Corning Glass Works	800.00
Trustees for the publication of physical and chemical constants	3,708.58
X. Geology and geography:	
General maintenance, 1920	741.58
General maintenance, 1921	115.49
XI. Medical sciences:	
General maintenance, 1920	1,594.08
General maintenance, 1921	13.53
(R. F. 2369) Rockefeller Foundation	7,437.38

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Divisions.			
XII.	Biology and agriculture:		
	General maintenance, 1920	$1,709.08	
	General maintenance, 1921	680.55	
	Botanical Abstracts, 1921		
	Committee on forestry	219.85	
	Food and nutrition committee	527.48	
	Food products investigation fund	461.57	
	Physiological salt requirements committee, 1921		
	Tropical Research Institute project, 1921	229.36	
	Rosenwald fellowship	500.00	
XIII.	Anthropology and psychology:		
	General maintenance, 1920	1,814.59	
	General maintenance, 1921	806.69	
	American archæological project, 1921	17.80	
	Executive board:		
	General maintenance, 1920	1,818.61	
	General maintenance, 1921	1,433.22	
	American Geophysical Union, 1921	57.50	
	Publicity committee:		
	General maintenance, 1920	715.80	
	General maintenence, 1921	510.25	
	Publications:		
	1920	6,103.92	
	1921	468.87	
	Contingent expenses:		
	1920	724.81	
	1921	2,173.02	
	Electric light, 1920	533.13	
	Electricity, 1921	165.50	
	General expense, printing, 1920	318.75	
	General and office expenses, 1919	252.44	
	Expenses and supplies:		
	1920	2,125.71	
	1921	2,518.61	
	Fuel, 1921	956.11	
	Hall clock, 1920	10.50	
	Moving from 1201 Sixteenth Street, NW., 1920	248.00	
	New equipment, general, 1921	406.81	
	Rent:		
	1920	2,708.34	
	1921	4,375.00	
	Salaries:		
	1920	62,436.74	
	1921	58,452.37	
	Telephone, 1920	65.81	
	Telegraph, 1920	18.38	
	Telephone and telegraph:		
	1920	575.76	
	1921	321.61	
	Towels, 1920	70.00	
	Purchase of United States Treasury certificates	80,564.77	
			$336,305.47
Cash on hand Dec. 31, 1920		28,305.26	
Cash invested Dec. 31, 1920, unappropriated fund, special		3,100.00	
			31,405.26
			367,710.73

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The year 1920 as used in the above table covers the period from July 1, 1919, to June 30, 1920, while the year 1921 as used in the above table covers the period from July 1, 1920, to June 30, 1921.

F. L. RANSOME, *Treasurer.*

JANUARY 15, 1921.

REPORT OF THE AUDITING COMMITTEE.

WASHINGTON, D. C., *January 15, 1921.*

We have employed the Capital Audit Co. to scrutinize and report on the treasurer's books. We accepted the certificate dated January 4, 1921, of the American Security & Trust Co., regarding notes owned by the Academy and deposited for collection; we have examined the securities and papers contained in the box of National Academy of Sciences at the vault of the American Security & Trust Co. We find them to correspond to the list checked by the auditing committee on January 15, 1919, except as modified by transactions of the year 1920 reported by the Capital Audit Co. We find that the coupons due in 1920 have been cut and accounted for, and those due January 1, 1921, have been deposited and are accounted for by appropriate entries in the pass books. Coupons due February 1 and March 1, 1921, have been detached and deposited for collection, as shown by memorandums signed by officials of the American Security & Trust Co. and Riggs National Bank. We find that interest on loans has been accounted for. Correspondence between vouchers, pass books, and accounts of the treasurer is certified by the Capital Audit Co. We find the net balance reported by the treasurer as of December 31, 1920, to accord with the statement of the American Security & Trust Co. and with the check book.

In addition to the financial statement of the treasurer covering the accounts of the National Academy proper, there is also a statement of the accounts of the National Research Council, whose funds are deposited in various separate accounts to the credit of the Academy. These accounts have been included in the report of the Capital Audit Co. We accepted the certificate dated January 3, 1921, of the Riggs National Bank as to United States Treasury certificates of indebtedness owned by the National Research Council and held by the bank for collection. We find that the net balance reported by the treasurer as of December 31, 1920, agrees with the statements of the American Security & Trust Co. and of Riggs National Bank for these accounts.

L. O. HOWARD,
AUGUSTUS TROWBRIDGE,
Auditing Committee.

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DECEASED MEMBERS.

LOUIS VALENTINE PIRSSON.

By WHITMAN CROSS.

[American Journal of Science, September, 1920, Vol. L, No. 297, pp. 173-187.]

In the death of Louis Valentine Pirsson, professor of physical geology in Sheffield Scientific School, which occurred on December 8, 1919, there passed from this life a notable investigator, writer, and teacher in the field of geology, a markedly able executive in university work, and a man of many lovable and admirable personal traits. He was taken at the time when his power of utilizing wide knowledge and mature judgment was at its maximum, and American geology has, in his untimely death, suffered severe loss.

It is proposed in this notice to dwell particularly on the personality of the man as exhibited in divers directions during his career rather than to furnish that fuller statement of his life and appraisal of his work which will be given in other more extended memoirs. Pirsson's accomplishments were due not so much to an inborn unquestionable and controlling impulse to a special field of scientific work as to an inherent fine quality of mind which, combined with a great love of nature, made it inevitable that some field of natural science should appeal strongly to him.

Looking first to the influence of ancestry as a source for certain characteristics, it is to be regretted that the data are meager. Pirsson's great-grandparents on his father's side came from Chelmsford, Essex, England, to the vicinity of New York, where the great-grandfather, William Pirsson, jr., taught school for a time. A son of this William Pirsson, who married Emily Morris, of New York City, became a manufacturer of pianos and lived in the suburbs of Fordham. It was in the comfortable home of this grandfather that Louis was born, on November 3, 1860, the son of Francis Morris and Louisa M. (Butt) Pirsson. His parents were very young, the father not yet established in life, and Louis lived at his grandfather's home until after the death of his mother, which took place when he was but 4 years old. There is but slight record of the mother beyond the impression that she was a woman of refinement and possessed of much personal charm. On the father's side there is some evidence of artistic temperament. Pirsson himself records, without reference to individuals, that members of his family were as a rule interested in some form of natural science.

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When Louis was nearly 9 years old he became the ward of Thomas Lord, of New York City, whose wife was a cousin of his father. The Lords were fond of travel and spent several years abroad soon after assuming this guardianship, so Louis was placed in the family of Rev. William J. Blain, living on a small farm near Amsterdam, N. Y. Mr. Blain was the pastor of a small Presbyterian church and was obliged to augment his slender salary by the return for such services and the produce of a few acres of land. Louis was treated as a member of the family, whose head was a strict disciplinarian of almost puritanical ideas, but he was also a good teacher, and from him Louis received the greater part of his primary education. He was also given a thorough training in the strict and regular performance of many small duties which were a part of the regimen necessary for this family. But it was not all work, for Mr. Blain had an excellent library, and here the boy early acquired a strong taste for reading of good literature.

After a few years Mr. Blain took another boy into his family to care for and educate, and in the newcomer Louis found the companion needed to assist in developing his latent love for natural history. The following passage from an outline of his early life is significant:

> Practically with the advent of this boy my scientific career began. I had been fond of reading books on natural history, some of which I found in Mr. Blain's library and others which had been sent me by relatives. As soon as I had an active companion we immediately began to go afield. We collected birds' eggs, minerals, and snakes, had a museum in the woodshed, and called ourselves naturalists. The neighboring brooks furnished material for an aquarium which we built. Interest in some form of natural history had existed in most of my family. Up to the time I entered college, and even later, birds were my chief interest. Only circumstances prevented me from becoming a zoologist.

Louis remained in Mr. Blain's family until the autumn of 1876, when he was nearly 16 years old. At that time his guardian placed him in Amenia Academy, Dutchess County, N. Y. Two years later this school was transferred to New Marlboro, Berkshire County, Mass. This school was clearly not of high grade, but when it was decided that Louis was to go to college it was the influence of the principal, a Yale man, that sent him to New Haven, and the boy's own desires that made him enter the Sheffield Scientific School, which he did, under the handicap of several conditions, in 1879.

Reviewing these early years it is clear that the boy who was denied the surroundings and affectionate care of a home was, after all, fortunate in some important respects. Under Mr. Blain he had learned to do appointed tasks with regularity and thoroughness and gained a sense of responsibility for the discharge of a duty. This he gratefully acknowledged in after years. The life in the country or in small villages was that suited to the physical develop-

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ment of a child who was not strong and gave opportunity for the independent development of an inborn tendency toward natural science.

From 1872 until near the middle of his college course Louis spent much of his summer vacations at the seashore with his guardian, who was at that time enjoying a large income and was very fond of yachting, fishing, and other costly sports. The boy had ample opportunity to become fully acquainted with the luxurious pastimes and other diversions of social circles of much wealth. While he enjoyed much of this life to the full, his notes of these years show that he always turned with still greater satisfaction to visits with friends of school days, especially at New Marlboro, where he renewed his rambles as a naturalist and fisherman.

Of Pirsson's college years there is, in his own phrase, "but little to say." He quickly overcame his entrance handicap and graduated with honors in 1882. In the midst of his college course his guardian suffered severe financial reverses, involving, to some extent, the slender capital of his ward. Partly from this condition and partly from interest, Pirsson gave special attention to chemistry, particularly to analytical work, as likely to lead to a future financial return.

The period of seven years following Pirsson's graduation was one of a hard struggle to earn a living while pursuing his own studies in chemistry looking toward a career as teacher and investigator. He paid his debts and became self-supporting. He also succeeded in establishing himself as a teacher of analytical chemistry, he made many valuable friendships continuing through life, but he did not really "find himself" by discovering the field of scientific work in which he was best adapted to engage with enthusiasm.

For two years he supported himself by odd jobs, assisting in the chemical laboratories of Profs. Allen and Mixter and in the physical lectures by Prof. Lyman. He also worked in the Sheffield library at this time, and, as in several succeeding years, he earned a large part of his scanty income by tutoring. Prof. Allen's health was poor, and during the academic year 1884–85 he was absent, the laboratory being placed in charge of H. L. Wells, with Pirsson and T. B. Osborne as assistants. Later, on Allen's retirement, Wells became his successor with Pirsson as first assistant. This relation continued until the summer of 1888.

During these years Pirsson became an expert analyst and attempted to begin a career as an investigator, but he felt the lack of fundamental training in research methods and it was not until later years that he found the proper field for the successful application of his skill as an analytical chemist.

The school year 1888–89 Pirsson spent at the Brooklyn Polytechnic Institute, nominally as professor of analytical chemistry but actually

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called on for elementary instruction in several sciences. Such a position was naturally not suitable for a man desiring a career as an investigator.

In the summer of 1889 the opportunity appeared through which Pirsson was to recognize beyond any question the line of scientific work which appealed most strongly to him. Through his kindly and constant friend Prof. Brush, he was offered the position as field assistant in the party of the United States Geological Survey under Arnold Hague, engaged in the study of the Yellowstone National Park. He was actually occupied as immediate assistant to Joseph P. Iddings and Walter H. Weed, with both of whom he was to maintain intimate relations for many years. While Pirsson had very little training to qualify him as a useful assistant in geological field work and he records that it seemed to him that he did not learn much, still, the man and his job had been brought together. He returned to New Haven after the field season, determined to become a geologist.

The first step was to take up crystallography, advanced mineralogy, and petrography under Prof. Penfield. From this inspiring teacher, able investigator, and close friend Pirsson got the thorough training in research methods which he needed. His instructor's enthusiasm was contagious and the year passed very happily. A second season on the Geological Survey, in 1890, with Iddings and Weed, in the survey of the Livingston quadrangle, Montana, confirmed the decision to go into geology. A few months more of work in Penfield's laboratory, and Pirsson was ready for the next step, a year and a half abroad, traveling and studying petrography and allied geological branches with Rosenbusch in Heidelburg and with Fouqué, Mallard, and Lacroix in Paris.

Pirsson was exceptionally prepared to profit by this experience under German and French masters of petrology and he made full use of his opportunities. He was sufficiently matured in his general scientific point of view to preserve his independence in thought and hence never came thoroughly under the spell of the great German master, who was accustomed to demand implicit confidence from his pupils. It is noteworthy that his constant aim was to secure the maximum benefit from his studies. Neither at this time nor later did it seem worth while to work for a doctor's degree, which he never obtained. Heidelberg was at this time the Mecca for students of petrography, who flocked there from all parts of the world, and Pirsson was thus fortunately thrown into close association with several men destined to become leaders in petrographic work in their respective countries. With some of these men he long maintained a more or less intimate friendship.

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While abroad, Pirsson received an offer to become State mineralogist of Missouri and another, from Prof. Brush, to return to New Haven as instructor in mineralogy and lithology in the Sheffield Scientific School under Prof. Penfield, at the munificent salary of $1,000 per annum. He accepted the latter offer, of course, and entered on his duties in the fall of 1892.

In 1893 Pirsson was relieved of his work in mineralogy and took over the course in geology which had been given by Prof. Verrill. In 1894 he was invited to consider a transfer to Johns Hopkins University as successor to the brilliant teacher of petrology, George H. Williams, but his work had been recognized at the scientific school and he preferred to accept a promotion to the position of assistant professer of inorganic geology. In 1897 he was promoted to the full professorship in physical geology, a position he held until his death.

From the time of his permanent connection with the Sheffield Scientific School the development of Pirsson's career was rapid in three directions: First as an investigator and author of notable contributions to the advancement of geology, second as a teacher and author of textbooks, and third in university administration. It seems advisable to consider separately these three phases of his busy and effective life.

In the field of research Pirrson possessed in fine development the natural qualifications of a true scientific investigator. He had a keen, logical, and philosophical mind, coupled with a lively imagination which he knew how to regulate. His powers of patient accurate observation and of concentrated attention were naturally associated with a highly retentive memory. He was very methodical in his plan of work from the beginning to the end of every important task. Thus when he came to take up his real life work he was exceptionally equipped. He had a thorough training in physics, chemistry, crystallography, and general mineralogy, and in his skill as an analytical chemist he possessed a tool which was to be of great service. Added to all this was a wonderful store of general knowledge which was often turned to good account.

Pirsson's researches fall naturally into a few groups. First come a series of mineralogical papers, some 10 in number, representing the results of his two years' work in Penfield's laboratory. These studies were made on specimens collected by himself or placed at his disposal by Prof. Brush. They are important as showing how completely he was equipped for such work whether involving the measurement and figuring of complex crystals or determining by analysis the chemical composition and discussing the same. After these first two or three years Pirsson did little detailed mineralogical investigation except on constituents of igneous rocks.

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Following his purely mineralogical studies Pirsson plunged at once into a series of broad petrologic investigations in Montana. Those researches were a direct outgrowth of his experience in the Geological Survey, especially in 1890, when a glimpse of the Crazy Mountains on the northern border of the Livingston quadrangle indicated the rich field for study lying farther north in similar laccolithic mountain groups, east of the Rocky Mountains proper. The investigations in the field were carried out in 1893, 1894, and 1896, in association with W. H. Weed of the Geological Survey, when the Castle, Little Belt, Highwood, and Judith Mountain groups were examined. Mr. Weed examined the Bearpaw and Little Rocky Mountains alone in 1895, and collected specimens of the igneous rocks to be studied by Pirsson. The description of these mountain groups, especially as to their igneous geology and petrography, issued by the Geological Survey in a number of joint papers and in periodicals, together with several articles by Pirsson alone, forms one of the most important contributions to American petrology. Pirsson's share in this work was a large one, extending beyond the purely petrologic discussion.

The various publications giving the results of this work are among the most widely known and highly valued of all petrological contributions of the past 25 years. Their importance lies in several directions. They gave a great deal of evidence concerning the nature of laccolithic type of igneous intrusion as the primary cause of isolated mountain groups in a plain country and confirmed the general ideas of Gilbert on this subject. Pirsson's powers as an observer, combined with his skill in graphic illustrations and in clear description, render the petrologic portions of these reports of special value.

The chemical analyses, mostly made by Pirsson, and the microscopical study of the rocks revealed many interesting rock types, some of them quite new to science. The character and relations of these rocks were accurately established and clearly described, furnishing an important contribution to systematic petrography. But Pirsson was keenly alive to the questions of genesis and secured from this material many valuable hints as to the difficult subject of magmatic differentiation and genetic relations.

Finally he presented a survey of the established facts which went far to substantiate and illustrate the idea of regional characteristics of igneous rocks which lead to the current designation of certain areas as "petrographic provinces." That of central Montana as established by Pirsson is one of unusual general interest.

Pirsson's increasing university duties prevented his entering further on field work of considerable magnitude. But he turned to the study of promising areas in New Hampshire near Squam Lake, where he spent many summer vacations. In association with H. S. Washington he undertook the study of the Belknap Mountains, south

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of Lake Winnepesauke, and of Red Hill on the eastern side of Squam Lake. A similar study of Tripyramid Mountain, on the south side of the White Mountains, was underaken in collaboration with William North Rice.

In addition to the districts with which his published articles dealt he gained a first-hand knowledge of and examined with considerable care many other important localities and entertained for a time a project of extended research in New Hampshire, but the increasing demands of college duties interfered with this plan.

In these researches modern methods of petrographic study brought out the existence of many important rock types with interesting genetic relationships which earlier work had not diclosed. In all this work Pirsson was always mainly interested in making a contribution to our knowledge of the origin of the chemical and mineral differences in igneous rocks—petrogenesis. He had little interest in petrographic description per se.

Pirsson's field researches were mainly confined to Montana and New Hampshire, but he was quick to see the importance of chance observations in many directions and interested others to follow up the more promising leads where he could not do so. Thus, through a visit to Bermuda, he learned of the geological results of a deep boring for water, and by cooperation with Drs. Vaughan and Cushing, of the United States Geological Survey, and Dr. Thomas, of the British Survey, an important contribution was made to our knowledge of this mid-Atlantic island.

The philosophical side of the investigator was always prominent in Pirsson's publications. The Montana work led to special discussions of "Complementary rocks and radial dikes," a review of significant relations of the "Phenocrysts of igneous rocks," and the paper above mentioned on the "Petrographic province of Montana."

His main work was done in a period when thoughtful petrographers of various countries were endeavoring to select from the mass of detailed knowledge accumulated in a few decades the criteria upon which might be based a much needed contribution to the systematic classification of igneous rocks. Pirsson's accurate and extensive knowledge of the rocks, his originality, and good judgment naturally made him one of a group of American petrographers who jointly undertook in 1898 the task of formulating an entirely new system, on a new basis, and supplying the necessary terminology.

The group of men who accomplished this task—consisting of Pirsson, Iddings, Washington, and the writer—embraced men of different temperaments and mental characteristics, with views originally conflicting on many points. Success in reaching an agreement was rendered possible only through the influence of qualities such as Pirsson possessed in most notable degree. These qualities

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were recognized by his colleagues in making him the "moderator" of numerous conferences where he was charged to bring about the necessary moderation of extreme views occasionally expressed, as well as to guide the discussions. His judicial temperament and constructive ability made him a very effective member of the group.

The ideal college or university teacher is unquestionably one who possesses enthusiasm as an instructor, an extensive, accurate knowledge of his subject, the power of clear presentation and explanation and, in addition, that close touch with the problems of the science which can only come with experience as an investigator. In Pirsson this ideal was realized in high degree. His experience with undergraduates in chemistry, mineralogy, and geology extended over 37 years, and with graduates to about 25 years, largely in petrology.

Pirsson was greatly interested in both classes of students, though it is probably true that the training of the graduate men afforded him the greater pleasure. He gave a great deal of earnest, conscientious attention to the effective presentation of a difficult subject to the underclass men. He had his own ideas as to how this should be done, and his scheme is preserved in the textbook soon to be referred to.

It was Pirsson's aim in presenting geology to beginners to arouse their interest, not so much by a general statement in attractive form, appealing specially to their imagination, as by giving them a clear connected outline of the more essential facts of earth history arranged in the logical order of the science. Or, as Prof. Schuchert has expressed it, "To undergraduates Pirsson was a good teacher, holding them not by picturesque or fascinating language but by his knowledge of his subject and his clear and fluent presentation of it."

Nearly 20 years ago Pirsson and his colleague, Charles E. Beecher, planned a textbook in geology for undergraduates, but the death of the latter in 1904 prevented the execution of the plan. Some years later, in collaboration with Prof. Schuchert, the plan for a "Textbook of Geology" was revived and the work was published in 1915. The success of the book has been notable. Some 15,000 copies of the "physical geology" part of this textbook have been sold, and a thoroughly revised edition, which the author completed but a few months before his death, is about to appear. It may be of interest to record the origin of one feature of the "physical geology" which illustrates the logical methods of the author, while the success of the book seems to indicate the soundness of his judgment on an important point in textbooks.

When planning the book Pirsson examined a considerable number of corresponding textbooks by well-known authors, with the object of ascertaining the relative weights which different men had given to different branches of the subject, as represented by space. He found that every author gave a disproportionate amount of space to

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his own specialty. Disregarding this special branch of each work he secured an average weight assigned by the authors in question to the principal topics, aside from the one in which prejudice had been displayed. Pirsson thought that the proper balance of treatment would be more nearly secured by accepting such an average than by using his own judgment; and this average was adopted for his physical geology.

The textbook was planned for the undergraduate, and Schuchert tells of Pirsson's repeated injunction that the geologist's desires or needs must not be allowed to influence the presentation.

Pirsson's aim to adapt his presentation to the needs of a particular group was further illustrated by the textbook Rocks and Rock Minerals, intended to meet the need of the mining engineer and geologist alike for a simple classification and nomenclature for rocks applicable in the field on megascopic examination. This book has been widely used.

Pirsson had long projected in his mind a textbook of petrology for advanced students. He gave a great deal of thought to the plan of this work, which had many original features. It was to cover the broad field of the origin, composition, texture, and classification of igneous rocks, and express the author's judgment, after 30 years of experience, as to the best method of teaching this difficult subject. Perhaps a third of the book had been prepared in its first draft. It is greatly to be regretted that it can never be finished, though certain chapters may be found adapted to publication.

A very considerable number of well-known geologists, teachers, and mining engineers have received a large part of their training in physical geology and petrology from Prof. Pirsson. Among these is a notable group of members of the United States and Canadian Geological Surveys. Pirsson's students were always impressed with his extensive, accurate knowledge of his subject and found him a master of clear, concise statement, yet patient in the explanation of difficult points. He was keen to perceive the individual student's weaknesses and quick with help to remedy them. Remembering a lack in his own early training, he paid special attention to instruction in the best habits and methods of research and to instilling into advanced students the high ideals of the seeker after truth which were so prominent in his own character. He was himself "uncompromising with the facts of a problem in hand" and laid wholesome stress upon this principle.

A trait of much influence which was highly appreciated was the sincere, kindly, and truly friendly interest Pirsson always exhibited in the progress of a student's work.

Prof. Pirsson was not only an investigator of high rank and a successful teacher but his interest in and understanding of the

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broad problems of university administration were such as to mak him a most valuable officer of the Sheffield Scientific School. This phase of his career has been so happily described by his long-time friend and colleague, Prof. Chittenden, that it is a pleasure to quote this tribute, kindly prepared at the writer's request, by the one best qualified to speak of these activities.

Prof. Pirsson possessed many traits of character rarely combined in one individual. The charm of his personality, his high ideals, his kindly manner, all helped to endear him to his associates; while his good judgment and forceful convictions were always respected by those with whom he worked. Endowed not only with clearness and keenness of mind which rightfully belong to one trained in the methods of science, he had benefited from the special opportunities he had enjoyed as a student of geology to cultivate habits of careful and discriminating observation. Thus, he had learned early in life the wisdom of forming judgment only after careful consideration of all the facts obtainable, and with due regard to relative values. As a result, he was a highly valued member of the governing board of the Sheffield Scientific School, to which he was elected in 1897, at the time of his appointment as professor of geology. Further, his keen sense of duty and personal responsibility in any work upon which he entered all combined to make him an especially useful member of the governing board, and he soon became closely identified with the life of the institution.

In 1898, he was made secretary of the governing board, which position he held for many years. Later, he assumed the duties of class officer of the senior class and chairman of the discipline committee. In this way he was brought closely in touch with matters pertaining to the student body, and here particularly he manifested that kindly and sympathetic interest which showed in all his dealings both with colleagues and students. The undergraduates recognized in him a friend, as well as adviser. They appreciated, in full measure, his fairness as a disciplinarian and his sympathy as a friend. In matters of large importance, educationally and otherwise, such as a university faculty naturally has to deal with, his opinions and views were always listened to with interest, even by those who might differ from him, and his judgment was invariably respected. Few men, professors in a university, are called upon to serve in so many and varied capacities as Prof. Pirsson was during the period of his active work in the Sheffield Scientific School.

In 1912, Prof. Pirsson was elected a member of the board of trustees of the Sheffield Scientific School. This brought him in contact with problems of a different kind—largely financial; and here, too, his good judgment and breadth of vision made him a valued member of the board.

During a period of more than two decades of active work Prof. Pirsson assumed, in full measure, all the responsibilities which his position carried with it. As a teacher he was forceful and painstaking, as an investigator in his chosen field of work he was an enthusiast, and yet he was always ready to give freely his time and thought to the many questions constantly arising in an educational institution. Whatever he did he did well. This simple statement may perhaps be taken as best illustrating the character of the man. Careful, thoughtful, painstaking effort was given to everything Prof. Pirsson undertook. Hence, he could be relied upon, and for this very reason he was frequently overtaxed by burdens of many kinds which a less cooperative man would have refused to carry. He was the embodiment of the true university professor, whether viewed from the standpoint of the teacher or investigator in his chosen field of science, as adviser of inquiring students, or as worker in faculty or committee. Above all, he was the embodiment of unselfish devotion to duty.

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Pirsson served as an associate editor of the American Journal of Science from 1899 to the time of his death. He was painstaking and conscientious in furnishing, with characteristic generosity of time and labor, brief but pointed notices of many geological publications. About 40 of his original papers also appeared in this Journal.[1]

The recognition of Pirsson's contributions to geology brought him membership in the National Academy of Sciences, the Geological Society of Stockholm, Sweden, the Washington Academy of Sciences, the American Academy of Arts and Sciences, and the Connecticut Academy of Arts and Sciences. He was a fellow of the Geological Society of America, of which he served as vice president in 1915.

Many of the qualities and accomplishments which were necessary to Pirsson's professional success were also notable in social life, where he was a charming companion. The power of accurate observation, guided by a broad and most intelligent interest, permitted him to make the best use of the opportunities afforded by extensive travel in many countries and by wide acquaintance with professional people. He had a wonderful fund of experience and information, while a keen sense of humor insured a delightful flavor to many of his tales of experience. He was fond of a good story and was himself a skilled raconteur.

Many of Pirsson's friends will recall with great pleasure evenings spent during the decade 1885 to 1895 with a group mainly of young instructors and associate professors, in quarters they occupied in the attic of the old Sheffield Hall. Among these "attic philosophers," as they came to be known in New Haven, were S. L. Penfield, H. L. Wells, C. E. Beecher, and Pirsson. After the day's work was ended it was the custom of these men to gather in the central hall under the roof with their chance guests and talk on whatever the work or the events of the day suggested, in serious or in lighter vein as the case might be. It was good talk, too, of the kind that helped or entertained. In these seances Pirsson's talents and resources showed to great advantage. His fund of information and store of anecdote made him a leader in the group of notable men named.

Pirsson was a hard, persistent worker. Many forms of relaxation did not appeal to him. But there was one sport which he enjoyed most heartily. He was a true disciple of Izaak Walton. From boyhood through life he rarely failed to devote several weeks of each year to trout fishing. His keenest pleasure was in fly fishing for the game trout of the Yellowstone, of Maine, or of the brooks and ponds of the Berkshires. Season after season he returned to New Marlboro, where as a boy he had become familiar with the pools and rapids in

[1] For a full bibliography of Pirsson's publications, see the forthcoming biographical memoir to be prepared for the National Academy of Sciences by Joseph P. Iddings.

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which the best sport was to be found. With an accuracy and care which were characteristic of the man, for many years Pirsson kept a special record of his fishing trips, giving exact dates, localities, companions, the spots where luck was best, the number and weight of the fish caught. The details of specially exciting contests were given in full and a tabular résumé of the season's catch ended the journal for each season.

Stories of the rambling naturalist and fisherman always aroused his enthusiasm and he wrote a number of tales of his own experiences which appeared under a nom de plume in Forest and Stream.

As the story of Pirsson's early life has shown, he was denied as a boy the joys and blessings of the intimate home circle. In New Haven, which became his home from the time of his entrance into the Scientific School, he gradually formed a circle of highly valued warm friends. In 1902 he was married to Miss Eliza Trumbull Brush, a daughter of his early teacher and close friend, Prof. George J. Brush.

Conscientious and unsparing devotion to manifold duties gradually had its effect on a constitution never rugged. A number of years ago Pirsson began to suffer from rheumatism, but he could not, at first, bring himself to give up his work and devote the necessary time to recuperation. Gradually his trouble developed into chronic arthritis, and the best of advice and the care of his devoted wife could only bring temporary relief. During periods of apparent improvement he continued his work at great cost. After a few months of intense suffering he passed away in December of 1919, in his sixtieth year.

In the course of this trying illness the beauty and dignity of his patient fortitude bore the heroic stamp and his solicitude for others and courteous appreciation of every attention never failed.

JOSEPH PAXSON IDDINGS.

By GEORGE P. MERRILL.

[American Journal of Science, October, 1920, Vol. L, No. 298, p. 316.]

Dr. Joseph Paxson Iddings died on Wednesday morning, September 8, 1920. Although it was known that his health had been failing for some time, his early death was not anticipated even by his most intimate friends until within a few days of its occurrence.

Dr. Iddings was one of the most widely and favorably known of American petrologists and his name will ever be associated with the development of microscopic petrology. He was connected with the United States Geological Survey from 1880 until 1895 and was professor of petrology at the University of Chicago until 1908, since which time he had devoted himself mainly to his private work, living at his country home in Brinklow, Montgomery County, Md. He was

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a man of excellent training, a careful, conscientious, and philosophic worker and, since his retirement from his professorship, had traveled extensively throughout the principal volcanic fields of the world with a view of completing his studies in vulcanism and volcanic products. His best-known publications are H. Rosenbusch's Microscopical Physiography of the Rock Making Minerals, 1898 (a translation); Rock Minerals, 1906; Igneous Rocks, 1909; and the Problem of Vulcanism, 1914. He was also one of the most active of the joint authors of the Quantitative Classification of Igneous Rocks. Numerous other of his writings are to be found in the periodicals and publications of the Geological Survey, among which may be mentioned the reports on rocks of the Eureka district, Nevada (Monograph XX), and of the Yellowstone National Park (Monograph XXXII).

Dr. Iddings was a man concerning whom it is difficult to speak in a wholly impersonal manner by one with as strong a feeling of attachment as the writer. He was not merely a geologist, but a man of broad culture and a gentleman, one who was always disposed to recognize the best in anyone and overlook that which was less favorable; a clean, healthful minded man of gentlemanly bearing such as made him friends wherever he went, and his loss will everywhere be deeply deplored.

SAMUEL J. MELTZER.

Resolutions Passed by the Scientific Staff of the Rockefeller Institute for Medical Research.

[Science, n. s. Vol. LIII, No. 1361, Jan. 28, 1921, p. 88.]

The scientific staff of the Rockefeller Institute for Medical Research has learned with profound grief of the death of Dr. Samuel J. Meltzer.

At a special meeting of the staff, held on November 12, 1920, it was resolved:

That an expression be recorded of the sense of great loss which his passing away has occasioned.

Dr. Meltzer has been associated with the institute from the time of its inception. His great learning, his devotion to medical science, and his love for his fellow men continuously prompted the expenditure of his utmost effort in the causes to which the labor of the institute is dedicated. In this service he spent wholeheartedly the last 16 years of his life, and in this service, in the fulness of his powers, he has died. He did not know how to spare himself in the devotion of his life to this great purpose.

The staff of the institute is conscious, however, not only of his service to the idea of the institute, but delights to recall the direction and purpose his inspiration gave to the development of medicine and medical research in the United States. His leadership and his con-

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tributions are second to the contributions of no other man in their significance for this generation of medical men. Dr. Meltzer's interest in humanity transcended the field of his medical activities. In the spirit of human cooperation he desired to include all men, so that there might flow across the boundaries of nations a desire for progress in the direction of universal ideals. These great interests were recognized, not only in this country but in Europe as well, and gave Dr. Meltzer a unique position as a lover of his kind.

These are the thoughts which the staff desires to record. They indicate how widely the influence of Dr. Meltzer was spread, how intensely his example was appreciated here.

The staff desires to convey its profound sympathy to the family of Dr. Meltzer, and in this resolution to acquaint them with a measure of the regard in which he was held. For the staff, Dr. Meltzer has not died; by the spirit of his example, he has helped to make the spirit of the institute, and this spirit will continue while the institute endures.

HARMON NORTHRUP MORSE.

By IRA REMSEN.

[From Science, n. s. Vol. LII, No. 1352, Friday, Nov. 26, 1920.]

After a long life spent in service in Johns Hopkins University, Prof. Morse died September 8, 1920, in the seventy-second year of his age. He was born October 15, 1848, at Cambridge, Vt., the son of a farmer, and died at Chebeague, Me., where he had spent his summers for many years. He was graduated from Amherst College in 1873, then went to Gottingen, and received the degree of Ph. D. from that university in 1875. The year 1875–76 was spent at Amherst as assistant in chemistry. In 1875 it was announced that the Johns Hopkins University would begin its work in the year 1876. Shortly after it became known that the writer of this notice was to be the professor of chemistry in the new university he received a call from Morse, who brought a letter of introduction from Emerson. This letter led me to take more than ordinary interest in the bearer. Whatever we were to do in Baltimore it seemed clear that I should need an assistant, and I told him I would in due time arrange for his appointment. Hearing a little later of the fellowships that were to be awarded I secured one of these for Morse and so his connection with the Johns Hopkins University began. Before the doors were opened, however, he was designated associate, and we began our work together for better or for worse. We had no laboratory. We had less than a handfull of students. What was to come of it? I need not go into the story thus suggested, except to say that we were absolutely untrammeled and left to work out our own salvation. Morse and I were of one mind as to the object to be attained and

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there were no discussions in regard to the methods to be adopted. They were not original, but they had never been tried in this country. There had never been an opportunity. The opportunity that many of us had hoped for, had dreamed of, was furnished by the bounty of Johns Hopkins and the wisdom of his trustees and of President Gilman.

Morse remained an associate until 1883, when he became an associate professor. In 1892 he was promoted to be professor of inorganic and analytical chemistry, and in 1908 he became director of the chemical laboratory. In 1916 he withdrew from active service and became professor emeritus.

From the beginning of our work in the new university the importance of research was emphasized. That was indeed its most characteristic feature. Morse was as anxious as any of us to take part in this work. For one reason and another it was some time before he got going. To be sure he did show his hand in some small and rather unpromising pieces of work and I think he became discouraged, but he was faithful to his teaching. Gradually, however, his researches opened up new fields and he began their exploration. This is not the place for a full review of his contributions, and those of his last years so overshadowed all that preceded that a reference to those alone will do substantial justice to his memory.

In the early nineties he turned his attention seriously to the question of the stability of solutions of potassium permanganate and in 1896 he published an article on "The production of permanganic acid by manganese superoxide," A. J. Hopkins and M. S. Walker appearing as joint authors. Pursuing this subject Morse and H. G. Byers in 1900 published an article "On the cause of the evolution of oxygen when oxidisable gases are absorbed by permanganic acid." The results were such that it became desirable to obtain an aqueous solution of pure permanganic acid. It was decided to prepare this by dissolving the heptoxide in water. In an article by Morse and J. C. Olsen that appeared in 1900 occurs the following passage:

> We accordingly prepared a quantity of the anhydride by mixing potassium permanganate and concentrated sulphuric acid in vessels cooled by ice and salt. We soon learned, however, that something more than a low temperature is essential to safety in handling the product; for a minute quantity of the anhydride—certainly less than half a drop—which had been separated from the sulphuric acid, exploded with great violence and with disastrous results to one of us [1] Some idea of the force of the explosion may be gained from the fact that one of the flying fragments of glass passed entirely through a burette which was mounted in the vicinity, leaving holes over half the diameter of the burette, edges of which were entirely free from cracks. After this experience, we decided to abandon the anhydride as a source of the acid, and to work out, if practicable, an electrolytic method of separating it from its salts.

[1] To make this story complete it should be added that Morse was the "one of us" here referred to. A piece of glass passed through the tissues of his neck in close proximity to the jugular vein. His escape from death was almost miraculous.

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The electrolytic method worked very satisfactorily, and led to the further use of this method in the preparation of osmotic membranes. The first results of this investigation are given in an article by Morse and D. W. Horn that appeared in 1901. They say:

In this connection, it occurred to the authors that if a solution of a copper salt and one of potassium ferrocyanide are separated by a porous wall which is filled with water, and a current is passed from an electrode in the former to another in the latter solution the copper and the ferrocyanogen ions must meet in the interior of the wall and separate as copper ferrocyanide at all points of meeting, so that in the end there should be built up a continuous membrane well supported on either side by the material of the wall. The results of our experiments in this direction appear to have justified the expectation and to be worthy of a brief preliminary notice.

This marks the real beginning of the work on osmotic pressure with which the name of Morse will always be associated. But before the cells were available and therefore before any reliable measurements could be made, years of patient, skillful work were still necessary. Difficulties that seemed insurmountable frequently arose and necessitated new efforts.

It must be said that some of us in the laboratory, including myself, at times lost faith in the ultimate success of the work and were perhaps inclined to advise the use of cells that were not perfect. But Morse went steadily on. He had in mind a practically perfect cell that could be used for high pressures as well as low. He tried all sorts and conditions of clay and after many, many discouragements he succeeded in finding one and in making a satisfactory glaze quite different from any available, and he achieved success.

In 1902 he and J. C. W. Frazer described "The preparation of cells for the measurement of high osmotic pressures." A careful reading of this article will give some idea of the tremendous difficulties that were met and overcome. The closing paragraph may be advantageously quoted in this connection:

The difficulties of construction are by no means completely overcome, and we have in view a number of changes which we hope will prove of advantage. That these difficulties are of great magnitude will be realized if one considers that in our last experiment the pressure which was measured and which was still below what we were called upon to control would suffice to raise a column of water at 20° to a point 15 meters higher than the top of the Eiffel tower, or which would raise from its base a marble shaft whose height is 120 meters. These comparisons will perhaps make it clear that the most painstaking attention to every detail of construction is absolutely essential to success when an apparatus like ours is to be made up of several parts, consisting of different materials, and which must be united without the usual mechanical means of securing strong joints.

Soon after this the Carnegie Institution of Washington lent its powerful aid to the large investigation thus begun. In 1914 the institution published a memoir entitled "The Osmotic Pressure of Aqueous Solutions: Report on Investigations made in the Chemical Laboratory of the Johns Hopkins University during the years 1899–

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1913. By H. N. Morse." In it is given a detailed account of this remarkable piece of experimental work. Any one who reads it understandingly will recognize that no one but a master of experiment could have done this. The work required the highest degree of resourcefulness and skill, of patience and persistence. Anyone of ordinary caliber would have stopped short of the accomplishment. Morse was not satisfied with anything but perfection as nearly as this could be reached, and as it never can be reached he worried about the residual no matter how small it might be. In the concluding chapter of the Carnegie Memoir occur these words:

> The work reported upon in the preceding chapters is only a fraction of the task which the author hopes to accomplish, or to see accomplished by others. The investigation—already 15 years old—was undertaken, in the first instance, with a view to developing a practicable and fairly precise method for the direct measurement of the osmotic pressure of aqueous solutions. The need of such a method for the investigation of solutions seemed to the author very great and very urgent.

Honors came to him rather late, but they came; the chief among these was the award of the Avogadro medal of the Turin Academy of Sciences, in 1916.

In 1911 an international congress of scientists assembled at Turin, Italy, to celebrate the centennial of the announcement of the hypothesis of Avogadro. Those in attendance decided to award a medal to be known as the Avogadro medal. This medal was to be awarded to the investigator who should, in the judgment of the awarding committee, make the most valuable contribution to the subject of molecular physics during the years 1912, 1913, and 1914.

A few words in regard to Morse, the man. He was quiet and uneffusive. He did not care for the ordinary intercourse with his fellowmen. He lived, when not in the laboratory, for his family and a few kindred spirits. He married twice and had four children—a daughter and three sons. His second wife, who was Miss Elizabeth Dennis Clark, of Portland, Me., his daughter and two sons survive him. In his later years his wife was of great assistance to him in preparing his articles for publication and was a true helpmate in every way.

For many years he spent his summers at Chebeague in the beautiful Casco Bay. Here he had a simple comfortable cottage and a garden. He delighted to work, both in and out of the house, and this gave him his exercise. He was rather stout and he knew that he needed exercise to keep his weight down. He therefore indulged in walking, bicycling, and finally in motoring, and he managed to keep fairly well. But, after his retirement in 1916, his health failed. His strength gave out and his courage also. He did not dare to take his car out of the garage, and his walks were very short. I saw him in May, just before he went to Maine, and thought he seemed more

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like his old self. He even talked of taking up his work again. It was not to be. I heard nothing from him after that. And then came the dispatch announcing his rather sudden and entirely unexpected death. He was buried at Amherst, a place that meant so much to him—where he had spent his college years and for sometime had had a summer home.

HORATIO C. WOOD.

[From Science, Jan. 30, 1920.]

Horatio C. Wood, M. D., LL. D., emeritus professor of materia medica, pharmacy, and general therapeutics in the University of Pennsylvania Medical School, died, January 3. The obituary notice in the Pennsylvania Gazette states that for three generations members of the Wood family have been on the medical faculty. Dr. George Bacon Wood, one of the founders of the Philadelphia College of Pharmacy, and an uncle of Horatio C. Wood, was professor of materia medica at Pennsylvania from 1835 until 1850, and professor of the theory and practice of medicine until 1860, when he resigned. Dr. Horatio Charles Wood, jr., is professor of pharmacology and therapuetics, having succeeded to one of the chairs held by his father when he retired. He is survived by these children: James L. Wood, Milford, Pa.; Dr. George B. Wood, Dr. Horatio Charles Wood, jr., and Miss Sarah K. Wood.

Dr. Wood was born in Philadelphia, January 13, 1841, a son of Horatio Curtis and Elizabeth Head Bacon Wood. His first American ancestor, Richard Wood, emigrated from Bristol, England, in 1682, settling first in Philadelphia and afterwards in New Jersey. Horatio C. Wood was educated at Westtown School and Friends' Select School, and was graduated from the medical department of the University of Pennsylvania in 1862.

In his youth he developed a fondness for natural history and before studying medicine became a worker in the Academy of Natural Sciences, distinguishing himself by his original work. After spending several years in hospitals, Dr. Wood began private practice in 1865, making a specialty of therapeutics and materia medica, meanwhile continuing his natural history studies and publishing numerous papers on this branch of science, especially cell botany. In his early life Dr. Wood also was a student of entomology and published 13 original memoirs upon the subject. He abandoned these studies after 1873 and devoted his whole attention to medicine.

He was appointed professor of botany in 1866 in the auxiliary faculty of medicine in the university which had been established and endowed by his uncle, Dr. George B. Wood, and held this position 10 years. He also made a special study of nervous diseases and upon the organization of the University Hospital in 1874 was

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appointed clinical lecturer, becoming professor in 1875 and retaining this chair until 1901. He also was professor of materia medica and therapeutics from 1875 until he retired.

Dr. Wood was the author of numerous medical and scientific works including Thermic Fever or Sunstroke, 1872; Materia Medica and Therapeutics, 1874; Brain Work and Overwork, 1880; and Nervous Diseases and their Diagnosis, 1874. In cooperation with Profs. Bennington and Sadtler he revised the United States Dispensatory.

Lafayette College conferred upon him the degree A. M., in 1881 and LL.D. in 1883. He received the degree LL.D. from Yale in 1889 and from the University of Pennsylvania in 1904. He was a member of many learned societies including the National Academy of Sciences, was president of the American Pharmacopœial convention from 1890 until 1910, and was president of the College of Physicians in 1902 and 1903.

DECEASED FOREIGN ASSOCIATE.

WILHELM WUNDT.

By E. B. TICHENER.

[From Science, n. s. Vol. LII, No. 1352, Friday, Nov. 26, 1920.]

The death of Wundt removes the foremost figure of our academic world; a great man of science, a philosopher of repute, a prolific writer, a personality of extraordinary influence. Psychology, the science with which his name is permanently connected, was fortunate both in the date of his birth and in the length of his life. He came into the world a full decade later than Helmholtz and Virchow and Du Bois and Leuckart, Huxley and Tyndall and Spencer, the standard bearers of science in the middle of the nineteenth century; so that, while his work and theirs overlapped, he still reaped the benefit of their pioneer labors. His length of days and the maintenance of his intellectual vigor not only enabled him to round off his manifold tasks—we all rejoice that the Völkerpsychologie is done, as we all rejoiced when Spencer published the final part of his Synthetic Philosophy—but also gave a much-needed stability to the young science of experimental psychology, whose name he coined and whose interest lay always nearest to his heart.

Wundt's outward life was uneventful. After a half-dozen years of study, principally in medicine, at the universities of Tubingen, Heidelberg, and Berlin, he settled down as docent (1857) and assistant professor (1864) of physiology at Heidelberg, where Helmholtz held the chair of physiology from 1858 to 1871. In 1874 he was called as professor of philosophy to Zurich, and in 1875 was chosen in preference to Horwicz (who nowadays reads the once famous Analysen?) as professor of philosophy at Leipzig. Here he remained till the end of his life, gathering in his harvest of academic honors: the rectorship

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of his university, the honorary citizenship of the town, the order pour la mérite, the title of wirklicher Geheimrat of the Kingdom of Saxony. He lived the simple family life of the older German tradition, and his days passed with the regularity of clockwork: the morning he spent on his current book or paper; then came the Sprechstunde; then, after the midday meal, his solitary constitutional in the park; then the formal visit to the laboratory; then the lecture; and then an informal gathering in the laboratory again. Wundt was an effective lecturer, and made no use of notes, though he always carried in his pocket a scrap of paper upon which notes had been made. He was devotedly cared for by his wife and, after her death, by his daughter, "meiner treuen Gefährtin im Urwald der Mythen und Märchen." His son turned some years since from philology to philosophy, and has written a valuable work upon Greek ethics.

Under these outward conditions, simple and sheltered, Wundt carried on his varied literary activities. If I were asked to pick out the most original and constructive items of his published work, I should name in the first place his "Beiträge zur Theorie der Sinneswahrnehmung" (1862), a rounded series of researches upon tactual and visual perception which contains in germ the doctrine of the later and better known Physiologische Psychologie. I should name, secondly, the Untersuchungen zur Mechanik der Nerven und Nervencentren (1871–1876), a solid bit of experimental investigation, quoted with respect by later physiologists. I should name, thirdly, the second part (Methodenlehre) of the Logik (1883 and later), which carries on the work of Mill and Jevons, but far outranks its predecessors in depth of insight and range of positive knowledge. I should name, fourthly, the highly characteristic "Psychologismus und Logizismus" of 1910; Wundt was at his best, constructively and historically, when he had been spurred into action by the success of what he thought a scientific heresy. And I should name, last, the little Einführung in die Psychologie (1911), a book in which Wundt's consummate mastery of his subject and the sweep and freedom of his style bring him as near as he ever came to the popular conception of a genius.

I have not included in this list the Grundzüge der physiologischen Psychologie. Everyone knows that Wundt founded, in 1879, the first laboratory of experimental psychology; and everyone knows that the "P. P.," as his students have dubbed it, is the standard work of reference for that science. The book was, no doubt, born of a great idea; and it is, without question, indispensable to the psychologist. But I do not think that it is a great book; that, in the very nature of the case, it could hardly be. Its one serious rival, Brentano's Psychologie vom empirischen Standpuncte, which ap-

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the light in the same year (1874), is great both in conception and so far as it goes—it goes only half way to its appointed goal—in execution; as late as 1907 Brentano had published only two minor corrections of his original text. But Wundt was attempting an impossible task, the welding of a highly imperfect nerve physiology to a rudimentary experimental psychology. He approached it with full scientific equipment and with no small measure of literary skill; the result, none the less, was inevitably an encyclopedic handbook of the two disciplines rather than a single physiological psychology. So it comes about that Brentano's Empirical Psychology stands to-day as it stood nearly 50 years ago, while the "P. P." has lumbered through edition after edition, hardly even aiming at system before the fifth (1902–1903), and still badly needing system in the sixth and last (1908–1911). The demand for these editions proves that the book is, as I said just now, indispensable to the working psychologist, and we can not be too grateful to Wundt for the time and labor spent upon the successive revisions. It would be a pity, however, if he were to be judged by a work which, characteristically thorough and painstaking as it is, still represents only one side, and that, perhaps, the least original, of his efforts on behalf of experimental psychology. The Wundt who organized the Leipzig laboratory, and who wrote or directed the investigations that fill the 20 volumes of the Philosophische and the 10 of the Psychologische Studien, is larger than the Wundt of the familiar book.

The long series of editions proves, of course, that the "P. P." has appealed to a far wider circle than that of the professional psychologists. Wundt, indeed, has always been singularly successful with his literary ventures. We expect that a class text, if it survives the first crucial year, will be often reprinted; but we do not expect that three-volume works on ethics and logic, to say nothing of a "System der Philosophie" which expresses its author's personal convictions in highly abstract terms, will again and yet again demand revision and reissue during their writer's lifetime. Such, nevertheless, has been Wundt's fortune. Most astonishing of all is the career of a semi-popular book, translated into English under the title "Lectures on Human and Animal Psychology"; first published in two volumes in 1863, it achieved its sixth edition, as a single volume, in 1919. Not that there is any real reduction in size—that has not been Wundt's habit. On the contrary, the lectures of the original edition that dealt with social psychology have simply been excluded and their modern equivalent published separately in the 10 large volumes of the Völkerpsychologie.

So we are brought to this tremendous achievement of Wundt's old age. He published the first two volumes, on Language, in 1900, when he was already nearly 70; he published the concluding volume, on

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Civilization and History, in 1920. The intervening volumes deal in turn with art, myth and religion, society and law. The whole undertaking grew out of Wundt's early conviction that psychological experiment breaks down on the far side of perception and memory, so that the processes of thought and of constructive imagination must be studied by other than experimental means. Hence a Völkerpsychologie is for him the direct continuation and supplement of experimental psychology. We may dispute his standpoint; we may question whether experiment fails where he makes it fail, and we may question further whether his own social psychology is not rather an application of his individual psychology to the data of social anthropology than the path to a discovery of new psychological principles. We may doubt also whether the time is ripe for generalization; whether there is not more to be gained by intensive labor. But no one who reads the book can fail to pay his tribute of admiration to its unfailing vitality, to its masterful ordering of detail, to its theoretical consistency. The Kultur und Geschichte ends on a somewhat forced note of optimism, beneath which there sounds—as how should there not?—a steady undertone of strained perplexity. Yet it is only here and there that the attentive reader discerns a momentary lapse either of style or of logic; the intellectual freshness is maintained to the end.

The significance of Wundt's whole work, if one tries to sum it up in a sentence, lies in the fact that he is the first considerable figure in the history of thought to attack the problems of science and philosophy from the psychological standpoint. Wundt was a born psychologist; and if others before him had a similar temperament, they had not the same opportunity. Wundt himself struggled into psychology, and never shook himself entirely free either of past philosophical systems or of the all-too-logical biology of the first Darwinian time. But he grew with the years. The last edition of the Physiologische Psychologie is better psychology than the first. He has often been compared with Herbert Spencer; he himself would prefer to be considered a modern follower of Leibniz. Neither comparison satisfies. Wundt was unique, and we shall not look upon his like again.

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APPENDIXES.

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APPENDIX A.

CONSTITUTION OF THE NATIONAL ACADEMY.

As amended and adopted Apr. 17, 1872, and further amended Apr. 20, 1875; Apr. 21, 1881; Apr. 19, 1882; Apr. 18, 1883; Apr. 19, 1888; Apr. 18, 1895; Apr. 20, 1899; Apr. 17, 1902; Apr. 18, 1906; Nov. 20, 1906; Apr. 17, 1907; Nov. 20, 1907; Apr. 20, 1911; Apr. 16, 1912; Apr. 21, 1915.]

PREAMBLE.

Empowered by the act of incorporation enacted by Congress, and approved by the President of the United States on the 3d day of March, A. D. 1863, and in conformity with amendments to said act approved July 14, 1870, June 20, 1884, and May 27, 1914, the National Academy of Sciences adopts the following amended constitution and rules:

ARTICLE I.—OF MEMBERS.

SECTION 1. The Academy shall consist of members, honorary members, and foreign associates. Members must be citizens of the United States.

SEC. 2. Members who, from age or inability to attend the meetings of the Academy, wish to resign the duties of active membership, may, at their own request, be transferred to the roll of honorary members by a vote of the Academy.

SEC. 3. The Academy may elect 50 foreign associates.

SEC. 4. Honorary members and foreign associates shall have the privilege of attending the meetings and of reading and communicating papers to the Academy, but shall take no part in its business, shall not be subject to its assessments, and shall be entitled to a copy of the publications of the Academy.

ARTICLE II.—OF THE OFFICERS.

SECTION 1. The officers of the Academy shall be a president, a vice president, a foreign secretary, a home secretary, and a treasurer, all of whom shall be elected for a term of four years, by a majority of votes present, at the first stated meeting after the expiration of the current terms, provided that existing officers retain their places until their successors are elected. In case of a vacancy, the election for four years shall be held in the same manner at the meeting when such vacancy occurs, or at the next stated meeting thereafter, as the academy may direct. A vacancy in the office of treasurer or home secretary may, however, be filled by appointment of the president of the Academy until the next stated meeting of the Academy.

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SEC. 2. The officers of the Academy, together with six members to be elected by the Academy, shall constitute a council for the transaction of such business as may be assigned to them by the constitution or the Academy.

SEC. 3. The president of the Academy, or, in case of his absence or inability to act, the vice president, shall preside at the meetings of the Academy and of the council; shall name all committees except such as are otherwise especially provided for; shall refer investigations required by the Government of the United States to members especially conversant with the subjects and report thereon to the Academy at its meeting next ensuing; and, with the council, shall direct the general business of the Academy.

It shall be competent for the president, in special cases, to call in the aid, upon committees, of experts or men of special attainments not members of the Academy.

The president shall be, ex officio, a member of all committees empowered to consider questions referred to the Academy by the Government of the United States.

SEC. 4. The foreign and home secretaries shall conduct the correspondence proper to their respective departments, advising with the president and council in cases of doubt, and reporting their action to the Academy at one of the stated meetings in each year.

It shall be the duty of the home secretary to give notice to the members of the place and time of all meetings, of all nominations for membership, and of all proposed amendments to the constitution.

It shall be the duty of the home secretary to keep the minutes of each business and scientific session, and after approval to enter these upon the permanent records of the Academy.

SEC 5. The treasurer shall attend to all receipts and disbursements of the academy, giving such bond and furnishing such vouchers as the council may require. He shall collect all dues, assessments, and subscriptions, and keep a set of books showing a full account of receipts and disbursements and the condition of all funds of the Academy. He shall be the custodian of the corporate seal of the Academy.

ARTICLE III.—OF THE MEETINGS.

SECTION 1. The Academy shall hold one stated meeting, called the annual meeting, in April of each year in the city of Washington, and another stated meeting, called the autumn meeting, at a place to be determined by the council. The council shall also have power to fix the date of each meeting.

Special business meetings of the Academy may be called, by order of eight members of the council, at such place and time as may be designated in the call.

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Special scientific meetings of the Academy may be held at times and places to be designated by a majority of the council.

SEC. 2. The names of the members present at each session of a meeting shall be recorded in the minutes, and 20 members shall constitute a quorum for the transaction of business.

SEC. 3. Scientific sessions of the Academy, unless otherwise ordered by a majority of the members present, shall be open to the public; sessions for the transaction of business shall be closed.

SEC. 4. Stated meetings of the council shall be held during the stated or special meetings of the Academy, and four members shall constitute a quorum for the transaction of business. Special meetings of the council may be convened at the call of the president and two members of the council, or of four members of the council.

SEC. 5. No member whose dues are in arrears shall vote at any business meeting of the Academy.

ARTICLE IV.—OF ELECTIONS AND RESIGNATIONS.

SECTION 1. All elections of officers and members shall be by ballot, and each election shall be held separately.

SEC. 2. The time for holding an election of officers shall be fixed by the Academy at least one day before the election is held.

SEC. 3. The election of the six members of the council shall be as follows:

At the annual meeting in April, 1907, six members of the council to be elected, of whom two shall serve for three years, two for two years, and two for one year, their respective terms to be determined by lot. Each year thereafter the terms of two members shall expire, and their successors, to serve for three years, shall be elected at the annual meeting in each year.

SEC. 4. The Academy shall be divided by the council into sections representing the principal branches of scientific research. Each section shall elect its own chairman, who shall serve for three years. The chairman shall be responsible to the Academy for the work of his section.

Nominations to membership in the Academy shall be made in writing and approved by a majority of the members of the section on the branch of research in which the person nominated is eminent, or by a majority of the council in case there is no section on the subject. The nomination shall be sent to the home secretary by the chairman of the section before January 1 of the year in which the election is to be held, and each nomination shall be accompanied by a list of the principal contributions of the nominee to science. This list shall be printed by the home secretary for distribution among the members of the Academy.

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SEC. 5. Election of members shall be held at the annual meeting in Washington in the following manner: There shall be two ballots—a preference ballot, which may be prepared either before or at the annual meeting, and must be transmitted to the home secretary, and a final ballot, to be taken at the meeting.

Preference ballot.—Each member may inscribe on a ballot not more than 15 names of nominees selected from the submitted list. A list of the nominees shall then be prepared, on which the names shall be entered in the order of the number of votes received by each. In case two or more nominees have the same number of votes on this preference list, the order in which they shall be placed on the list shall be determined by a majority vote of members present.

Final ballot.—A vote shall first be taken on the nominee who appears first on the preference list, and he shall be declared elected if he receive two-thirds of the votes cast and not less than 25 votes in all. A vote shall then be taken in similar manner on the nominee standing second on the preference list, and so on until all the nominees on the preference list shall have been acted on, or until 15 nominees shall have been elected, or until the total membership of the Academy shall have reached 250.

Not more than 15 members shall be elected at one annual meeting.

Before and during elections a discussion of the merits of nominees will be in order.

SEC. 6. Every member-elect shall accept his membership, personally or in writing, before the close of the next stated meeting after the date of his election. Otherwise, on proof that the secretary has formally notified him of his election, his name shall not be entered on the roll of members.

SEC. 7. Foreign associates may be nominated by the council and may be elected at the annual meeting by a two-thirds vote of the members present.

SEC. 8. A diploma, with the corporate seal of the Academy and the signatures of the officers, shall be sent by the appropriate secretary to each member on his acceptance of membership, and to foreign associates on their election.

SEC. 9. Resignations shall be addressed to the president and acted on by the Academy.

SEC. 10. Whenever a member has not paid his dues for four successive years, the treasurer shall report the fact to the council, which may report the case to the academy with the recommendation that the person thus in arrears be declared to have forfeited his membership. If this recommendation be approved by two-thirds of the members present, the said person shall no longer be a member of the Academy and his name shall be dropped from the roll.

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ARTICLE V.—SCIENTIFIC COMMUNICATIONS, PUBLICATIONS, AND REPORTS.

SECTION 1. Communications on scientific subjects shall be read at scientific sessions of the Academy, and papers by any member may be read by the author or by any other member, notice of the same having been previously given to the secretary.

SEC. 2. Any member of the Academy may read a paper from a person who is not a member, and shall not be considered responsible for the facts or opinions expressed by the author, but shall be held responsible for the propriety of the paper.

Persons who are not members may read papers on invitation of the council or of the committee of arrangements.

SEC. 3. The Academy may provide for the publication, under the direction of the council, of proceedings, scientific memoirs, biographical memoirs, and reports.

The proceedings shall include the transactions of the Academy, brief original announcements of the results of scientific investigations made by members of the Academy or others, together with short original articles giving a comprehensive survey of the more important scientific researches currently made by American investigators, and other matters of general scientific interest.

The scientific memoirs shall provide opportunity for the publication of longer and more detailed scientific investigations.

The biographical memoirs shall contain an appropriate record of the life and work of deceased members of the academy.

An annual report shall be presented to Congress by the president and shall contain the annual reports of the treasurer and the auditing committee, a suitable summary of the reports of the committees in charge of trust funds, and a record of the activities of the Academy for the calendar year immediately preceding, and other appropriate matter. This report shall be presented to Congress by the president after authorization by the council. It shall also be presented to the Academy at the annual meeting next following.

The treasurer shall prepare a full report of the financial affairs of the Academy at the end of the fiscal year. This report shall be submitted to the council for approval and afterwards presented to the Academy at the next stated meeting. He shall also prepare a supplementary financial statement to December 31 of the ensuing fiscal year for presentation at the annual meeting.

SEC. 4. Propositions for investigations or reports by the Academy shall be submitted to the council for approval, except those requested by the Government of the United States, which shall be acted on by the president, who will in such cases report their results to the Gov-

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ernment as soon as obtained and to the Academy at its next following stated meeting.

SEC. 5. The advice of the Academy shall be at all times at the disposition of the Government upon any matter of science or art within its scope.

ARTICLE VI.—OF THE PROPERTY OF THE ACADEMY.

SECTION 1. All investments and reinvestments of either principal or accumulations of income of the trust and other funds of the Academy shall be made by the treasurer, with the approval of the finance committee, in the corporate name of the Academy, in the manner and in the securities designated or specified in the instruments creating the several funds, or, in the absence of such designation or specification, in bonds of the United States or of the several States, or in bonds or notes secured by first mortgages on real estate, in investments legal for savings banks under the laws of Massachusetts or New York, or in other bonds recommended to the treasurer by the fiscal advisers of the Academy.

The treasurer may invest the capital of all trust funds of the Academy which are not required by the instruments creating such funds to be kept separate and distinct, in a consolidated fund, and shall apportion the income received from such consolidated fund among the various funds composing the same in the proportion that each of said funds shall bear to the total amount of funds so invested; provided, however, that the treasurer shall at all times keep accurate accounts showing the amount of each trust fund, the proportion of the income from the consolidated fund to which it is entitled, and the expenses and disbursements properly chargeable to such fund.

SEC. 2. The council shall at its annual meeting in each year designate one bank or trust company in Washington, D. C., and one in New York City to act, when requested by the treasurer, as the fiscal advisers of the academy.

SEC. 3. The treasurer shall have authority, with the approval of the finance committee, to sell, transfer, convey, and deliver in the corporate name and for the benefit of the Academy any stocks, bonds, or other securities standing in the corporate name.

SEC. 4. No contract shall be binding upon the Academy which has not been first approved by the council.

SEC. 5. The assessments required for the support of the Academy shall be fixed by the Academy on the recommendation of the council and shall be payable within the calendar year for which they are assessed.

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ARTICLE VII.—OF TRUST FUNDS AND THEIR ADMINISTRATION.

SECTION 1. Devises, bequests, donations, or gifts having for their object the promotion of science or the welfare of the Academy may be accepted by the council for the Academy. Before the acceptance of any such trust the council shall consider the object of the trust and all conditions or specifications attaching thereto. The council shall make a report of its action to the Academy.

SEC. 2. Medals and prizes may be established in accordance with the provisions of trusts or by action of the Academy.

SEC. 3. Unless otherwise provided by the deed of gift, the income of each trust fund shall be applied to the objects of that trust by the action of the Academy on the recommendation of a standing committee on that fund.

ARTICLE VIII.—OF ADDITIONS AND AMENDMENTS.

Additions and amendments to the constitution shall be made only at a stated meeting of the Academy. Notice of a proposition for such a change must be submitted to the council, which may amend the proposition, and shall report thereon to the academy. Its report shall be considered by the Academy in committee of the whole for amendment.

The proposition as amended, if adopted in committee of the whole, shall be voted on at the next stated meeting, and if it receives two-thirds of the votes cast it shall be declared adopted.

Absent members may send their votes on pending changes in the constitution to the home secretary in writing, and such votes shall be counted as if the members were present.

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APPENDIX B.

RULES.

[In accordance with a resolution of the Academy, taken at its meeting on Apr. 21, 1915, the rules are arranged in groups and each group is numbered to correspond with the article of the constitution to which it relates.]

I.

1. The holders of the medal for eminence in the application of science to the public welfare shall be notified, like members, of the meetings of the Academy, and invited to participate in its scientific sessions.

II.

1. The proper secretary shall acknowledge all donations made to the Academy, and shall at once report them to the council for its consideration.

2. The home secretary shall be the custodian of all books, apparatus, archives, and collections not explicitly assigned to other care.

3. The home secretary shall keep a record of all grants of money or awards of prizes or medals made from trust funds of the Academy. The assistant secretary, who may be a nonmember of the Academy, shall receive a salary to be fixed by the council. The record for each grant of money shall include the following items: Name of fund, date and number of the grant, name and address of recipient, amount of grant and date or dates of payment, purpose of grant, record of report of progress, and resulting publications.

4. The treasurer shall keep the home secretary informed of all warrants received from directors of trust funds not controlled by the Academy and of the date or dates of payment of all warrants.

5. The treasurer is authorized to defray, when approved by the president, all the proper expenses of committees appointed to make scientific investigations at the request of departments of the Government, and in each case to look to the department requesting the investigation for reimbursement to the Academy.

6. The treasurer is authorized to act as the treasurer ex officio of the National Research Council.

7. The treasurer shall have the assistance of a salaried and bonded officer, the bursar, who shall be chosen by the finance committee and be directly responsible to the treasurer.

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III.

1. The annual meeting of the Academy shall begin on the fourth Monday of April. At the business sessions of the Academy the order of procedure shall be as follows:

(1) Chair taken by the president, or, in his absence, by the vice president.
(2) Roll of members called by home secretary (first session of the meeting only.)
(3) Minutes of the preceding session read and approved.
(4) Stated business.
(5) Reports of president, secretaries, treasurer, and committees.
(6) Business from council.
(7) Other business.

2. The rules of order of the Academy shall be those of the Senate of the United States, unless otherwise provided by the constitution or rules of the Academy.

3. In the absence of any officer a member shall be chosen to perform his duties temporarily, by a plurality of viva voce votes, upon open nomination.

4. At each meeting the president shall announce the death of any members since the preceding meeting. As soon as practicable thereafter he shall designate a member to write—or to secure from some other source approved by the president—a biographical notice of each deceased member.

5. A local committee of five members, appointed for each meeting, and the home secretary shall together constitute the committee of arrangements, of which the home secretary shall be chairman.

It shall be the duty of the committee of arrangements to prepare the scientific program for the annual meeting, and for this purpose it shall be empowered to solicit papers from members or others. It shall also be empowered to ascertain the length of time required for reading papers to be presented at the scientific sessions of the Academy, and, when it appears advisable, to limit the time to be occupied in their presentation or discussion.

The committee of arrangements shall meet not less than two months previous to each meeting. It shall prepare the detailed program of each day, and in general shall have charge of all business and scientific arrangements for the meeting for which it is appointed.

6. No paper requiring more than 15 minutes for its presentation hall be accepted unless by invitation of the committee of arrangements.

No speaker shall occupy more than 30 minutes for presentation of papers during the scientific sessions of a single meeting of the Academy, except by invitation of the committee of arrangements.

Time shall not be extended except by vote of the Academy and then not to exceed five minutes. The presiding officer shall warn speakers two minutes before the expiration of their time.

82273°—S. Doc. 374, 66-3——11

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The discussion of individual papers shall be limited not to exceed five minutes and the total time for discussion by any one speaker for all scientific sessions in any one meeting shall not exceed 15 minutes, unless approved by the Academy.

No paper shall be entered upon the printed program of scientific sessions unless the title is in the hands of the committee of arrangements at least two weeks in advance of the meeting. In the event that titles are received later, they shall be placed in order of receipt at the end of the list and read, if there is time. Such supplementary titles shall be conspicuously posted.

IV.

1. The term of service of each chairman of a section shall be three years, to date from the closing session of the April meeting next following his election. Chairmen of sections shall be chosen by mail ballot, the member receiving the highest number of votes cast to be deemed elected. It shall be the duty of each retiring chairman to conduct the election of his successor and to report the result of the election to the home secretary before the April meeting at which his term of service expires. Should any section fail to elect a chairman before November 1, the president is empowered to appoint a temporary chairman to serve until the April meeting next following. No chairman shall be eligible for reelection for two consecutive terms.

2. The chairman of each section of the Academy shall submit to the members of his section, not later than November 1 of each year, a ballot containing the names of all those persons who received not less than two votes in the nominating ballot of the preceding year and of any other persons who were newly proposed for consideration at that time. Each member of the section shall be expected to return this ballot to the chairman within two weeks with his signature and with crosses placed against the names of those persons whom he is prepared to indorse for nomination. Each member may also write upon the ballot in a place provided for the purpose any new names which he desires to have included in the ballot to be submitted to the section in the following year. The vote resulting from this ballot shall be regarded as informal.

The chairman shall then submit to the members of his section a new ballot showing the results of the informal vote; and each member shall be expected to return this ballot to the chairman with his signature and with crosses placed against the names of those persons whom he will indorse for nomination. In order to secure an adequate number of nominations, the chairman, when necessary, shall obtain by personal solicitation a fuller vote of his section or shall submit to the section a supplementary formal ballot.

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The chairman shall then certify to the home secretary, prior to January 1, the names of those persons who have been voted for on the formal ballots by a majority of the members of the section, and shall furnish him a list of the publications of these nominees, as required by the constitution.

3. Nominations for membership shall give the full name, residence, and the official positions successively held by the candidate, in addition to the list of his contributions to science required by the constitution.

4. Preference ballots for election of members shall be sealed in a blank envelope, which shall be inclosed in another bearing the name of the sender, and which shall be addressed to the home secretary. Such envelopes shall be opened only by the tellers. If in any case the tellers are unable to determine who cast a ballot, or if the latter contains more names than are to be voted for, the ballot shall be rejected, but minor defects in a ballot shall be disregarded when the intent of the voter is obvious.

5. All discussions of the claims and qualifications of nominees at meetings of the Academy shall be held strictly confidential, and remarks and criticisms then made may be communicated to no person who was not a member of the Academy at the time of the discussion.

V.

1. The publication of the Proceedings shall be under the general charge of the council, which shall have final jurisdiction upon all questions of policy relating thereto. The preparation of the Proceedings for publication shall be intrusted to an editorial board. This board shall consist of a chairman and a managing editor, both of whom shall be appointed by the council for definite terms of service; of the home secretary and foreign secretary ex officiis, and of a body of associate editors representing the various branches of science which are to be included in the scope of the Proceedings. The managing editor, who may be a nonmember of the Academy, shall receive a salary, which shall be fixed by the council. It shall be the duty of the managing editor to prepare the Proceedings in detail for publication; but the chairman of the editorial board shall decide, in consultation with the managing editor, in regard to the acceptance, rejection, or substantial modification of papers offered for publication. The associate editors shall be appointed by the council, upon recommendation of the chairman of the editorial board, for a period of three years, one-third of them retiring annually. The home secretary and the foreign secretary shall be responsible for the distribution of the Proceedings in their respective fields.

2. Memoirs may be presented at any time to the home secretary, who shall report the date of their reception at the next session; but

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no memoir shall be published unless it has been read or presented by title before the Academy.

Before publication all biographical and scientific memoirs must be referred to the committee on publication, who may, if they deem best, refer any memoir to a special committee appointed by the president to determine whether the same should be published by the Academy.

3. Memoirs shall date, in the records of the Academy, from the date of their presentation to the Academy, and the order of their presentation shall be so arranged by the secretary that, so far as may be convenient, those upon kindred topics shall follow one another.

4. The annual report of the treasurer shall contain:

(1) A concise statement of the source, object, and amount of all trust funds of the Academy.
(2) A condensed statement of receipts and expenditures.
(3) A statement of assets and liabilities.
(4) Accounts with individual funds.
(5) Such other matter as he considers appropriate.

5. The accounts of the treasurer shall, between July 1 and August 1 of each year, be audited under the direction of a committee of three members to be appointed by the president at the annual meeting of the Academy. It shall be the duty of the auditing committee to verify the record of receipts and disbursements maintained by the treasurer and the agreement of book and bank balances; to examine all securities in the custody of the treasurer and to compare the stated income of such securities with the receipts of record; to examine all vouchers covering disbursements for account of the Academy including the National Research Council and the authority therefor and to compare them with the treasurer's record of expenditures; to examine and verify the account of the Academy with each trust fund. The auditing committee may employ an expert accountant to assist the committee in the examination of the books of the treasurer. The annual report of the treasurer shall be published with that of the president to Congress. The reports of the treasurer and auditing committee shall be presented to the Academy at the autumn meeting, and shall be published with that of the president to Congress. They shall be distributed to the members in printed form at the annual meeting.

VI.

1. All apparatus and other materials of permanent value purchased with money from any grant from a trust fund shall be the property of the Academy unless specific exception is made in the grant or by subsequent action of the council or the directors of the trust fund concerned. Receipts for all such property shall be signed by the grantee and shall be forwarded to the home secretary. All

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apparatus and unused material of value acquired in this way shall be delivered to the home secretary on completion of the investigation for which the grant was made, or at any time on demand of the council, and the home secretary shall give an appropriate release therefor.

2. The books, apparatus, archives, and other collections of the Academy shall be deposited in some safe place in the city of Washington. A list of the articles so deposited shall be kept by the home secretary, who is authorized to employ a clerk to take charge of them.

3. A stamp corresponding to the corporate seal of the Academy shall be kept by the secretaries, who shall be responsible for the due markings of all books and other objects to which it is applicable.

Labels or other proper marks of similar device shall be placed upon objects not admitting of the stamp.

4. The fiscal year of the Academy shall end on June 30 of each year.

5. The standing committee on finance shall consist of the president of the Academy ex officio, the treasurer ex officio as chairman, and five members to be appointed annually by the president, two of whom may be nonmembers of the Academy.

That a budget committee on the expenses of the National Academy and the National Research Council, to consist of the president of the Academy, the chairman of the National Research Council, and the treasurer of the National Academy of Sciences and the National Research Council, be appointed and the president of the Academy act as chairman.

VII.

1. Standing committees of the Academy on trust funds the income of which is applied to the promotion of research shall consist of three or five members. In order to secure rotation in office in such committees, when not in conflict with the provisions of the deeds of gift, the term of service on a committee of three members shall be three years; on a committee of five members the term shall be five years.

2. The annual reports of the committees on research funds shall, so far as the Academy has authority to determine their form, give a current number to each award, stating the name, position, and address of the recipient; the subject of research for which the award is made, and the sum awarded; and in later annual reports the status of the work accomplished under each award previously made shall be announced, until the research is completed, when announcement of its completion and, if published, the title and place of publication shall be stated, and the record of the award shall be reported as closed.

VIII.

1. Any rule of the Academy may be amended, suspended, or repealed on the written motion of any two members, signed by them, and presented at a stated meeting of the Academy, provided the same shall be approved by a majority of the members present.

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APPENDIX C.

ORGANIZATION OF THE ACADEMY, 1920-21.

	Expiration of term.
Walcott, Charles D., president	April, 1923
Michelson, A. A., vice president	April, 1923
Hale, George E., foreign secretary	April, 1922
Abbot, C. G., home secretary	April, 1923
Ransome, F. L., treasurer	April, 1923

ADDITIONAL MEMBERS OF COUNCIL.

1918–1921.

Pearl, Raymond — Howell, W. H.

1919–1922.

Carty, J. J. — Donaldson, H. H.

1922–1924.

Day, A. L. — Morgan, T. H.

SECTIONS.

1. MATHEMATICS.

Birkhoff, G. D.
Blitchfeldt, H. F.
Bliss, G. A.
Bolza, Oskar
Dickson, L. E.
Kasner, Edward
Moore, E. H.
Osgood, W. F.
Story, W. E.
Van Vleck, E. B.
Veblen, Oswald
White, H. S. (Chairman, 1922.)
Wilczynski, E. J.

2. ASTRONOMY.

Abbot, C. G. (Chairman, 1923.)
Adams, W. S.
Aitken, R. G.
Barnard, E. E.
Campbell, W. W.
Comstock, G. C.
Curtis, H. D.
Elkin, W. L.
Frost, E. B.
Hale, G. E.
Leuschner, A. O.
Moulton, F. R.
Russell, H. N.
Schlesinger, Frank
Seares, F. H.
Stebbins, Joel

3. PHYSICS.

Ames, J. S.
Barus, Carl
Bell, A. G.
Bridgman, P. W.
Bumstead, H. A.[1] (Chairman, 1923.)
Crew, Henry
Duane, William
Hall, E. H.
Hastings, C. S.
Hayford, J. F.
Lyman, Theodore
Mendelhall, C. E.
Mendenhall, T. C.
Merritt, Ernest
Michelson, A. A.
Millikan, R. A.
Nichols, E. F.
Nichols, E. L.
Pierce, G. W.
Pupin, M. I.
Rosa, E. B.
Stratton, S. W.
Thomson, Elihu
Trowbridge, Augustus
Trowbridge, John
Webster, A. G.
Wilson, Edwin B.
Wood, R. W.
Woodward, R. S.

[1] Died Dec. 31, 1920.

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4. ENGINEERING.

Abbot, H. L.
Carty, J. J.
(Chairman, 1923.)
Dunn, Gano
Durand, W. F.
Freeman, J. R.
Howe, H. M.
Jewett, F. B.
Ryan, H. J.
Squier, G. O.
Taylor, D. W.

5. CHEMISTRY.

Bancroft, W. D.
Baxter, G. P.
Bogert, M. T.
Boltwood, B. B.
Chandler, C. F.
Clarke, F. W.
Franklin, E. C.
Gomberg, Moses
Gooch, F. A.
Hillebrand, W. F.
Jackson, C. L.
Johnson, T. B.
Kohler, E. P.
Langmuir, Irving
Lewis, G. N.
Michael, Arthur
Morley, E. W.
Noyes, A. A.
Noyes, W. A.
(Chairman, 1922.)
Osborne, T. B.
Remsen, Ira
Richards, T. W.
Smith, Alexander
Smith, Edgar F.
Stieglitz, Julius
Wells, H. L.
Whitney, W. R.

6. GEOLOGY AND PALEONTOLOGY.

Branner, J. C.
Chamberlin, T. C.
Clarke, J. M.
(Chairman, 1921.)
Cross, Whitman
Dall, W. H.
Dana, E. S.
Davis, W. M.
Day, A. L.
Kemp, J. F.
Leith, C. K.
Lindgren, Waldemar
Merriam, J. C.
Osborn, H. F.
Pumpelly, Raphael
Ransome, F. L.
Reid, H. F.
Schuchert, Charles
Scott, W. B.
Ulrich, E. O.
Walcott, C. D.
White, David
Willis, Bailey

7. BOTANY.

Bailey, L. H.
Britton, N. L.
Campbell, D. H.
Coulter, J. M.
Goodale, G. L.
Harper, R. A.
Jones, L. R.
Osterhout, W. J. V.
Sargent, C. S.
Setchell, W. A.
Smith, Erwin F.
(Chairman, 1921.)
Thaxter, Roland
Trelease, William

8. ZOOLOGY AND ANIMAL MORPHOLOGY.

Allen, J. A.
Calkins, G. N.
Castle, W. E.
Conklin, E. G.
Davenport, C. B.
Donaldson, H. H.
Forbes, S. A.
Harrison, R. G.
Herrick, C. J.
Howard, L. O.
Jennings, H. S.
Lillie, F. R.
McClung, C. E.
Mark, E. L.
Mayor, A. G.
Merriam, C. H.
Morgan, T. H.
(Chairman, 1922.)
Morse, E. S.
Parker, G. H.
Pearl, Raymond
Ridgway, Robert
Verrill, A. E.
Wheeler, W. M.
Wilson, Edmund B.

9. PHYSIOLOGY AND PATHOLOGY.

Abel, J. J.
Armsby, H. P.
Benedict, F. G.
Cannon, W. B.
Carlson, A. J.
Chittenden, R. H.
Councilman, W. T.
Cushing, Harvey
Flexner, Simon
Folin, Otto
Halsted, W. S.
Hektoen, Ludvig
Henderson, L. J.
Howell, W. H.
Hunt, Reid
Jones, Walter
Levene, P. A. T.
Loeb, Jacques
Lusk, Graham
McCollum, E. V.
Mendel, L. B.
(Chairman, 1922.)
Prudden, T. M.
Smith, Theobald
Vaughan, V. C.
Welch, W. H.

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10. ANTHROPOLOGY AND PSYCHOLOGY.

Angell, J. R.	Dewey, John	Hall, G. S.
Boas, Franz	Fewkes, J. W.	Holmes, W. H.
Cattell, J. McK.	(Acting chairman.)	Thorndike, E. L.

STANDING COMMITTEES.

ON WEIGHTS, MEASURES, AND COINAGE.

Mendenhall, T. C. (Chairman).	Michelson, A. A.	Webster, A. G.
	Morley, E. W.	Woodward, R. S.

ON SOLAR RESEARCH.

Hale, G. E. (Chairman).	Michelson, A. A.	Nichols, E. L.
Campbell, W. W.		

ON PUBLICATION.

The President.	The Home Secretary.	Ross, E. B.

EDITORIAL BOARD OF THE PROCEEDINGS.

Pearl, Raymond (Chairman). Abbot, C. G. (Home secretary).
Wilson, Edwin B. (Managing editor). Hale, G. E. (Foreign secretary).

Clarke, J. M., 1921.	Hektoen, Ludvig, 1921.	Moore, E. H., 1923.
Day, A. L., 1922.	Henderson, L. J., 1922.	Noyes, W. A., 1921.
Duane, William, 1923.	Jennings, H. S., 1921.	Osterhout, W. J. V., 1922.
Dunn, Gano, 1922.	Merriam, J. C., 1922.	Schlesinger, F., 1923.
Harrison, R. G., 1923.	Millikan, R. A., 1921.	Wheeler, W. M., 1923.

ON COLLECTION OF HISTORICAL PORTRAITS, MANUSCRIPTS, INSTRUMENTS, ETC.

Walcott, C. D. (Chairman).	Hale, G. E.	Pupin, M. I.
Clarke, F. W.		

FINANCE COMMITTEE.

Ransome, F. L. (Chairman).	Dunn, Gano	Walcott, C. D.
Cross, Whitman		

TRUST FUNDS.

THE BACHE FUND.

[$59,000.]

Researches in physical and natural science.

Frost, E. B. (Chairman).	Harrison, R. G.	Webster, A. G.

THE WATSON FUND.

[$25,000.]

Watson medal and the promotion of astronomical research.

Leuschner, A. O. (Chairman).	Comstock, G. C.	Elkin, W. L.

THE HENRY DRAPER FUND.

[$10,000.]

Draper medal and investigations in astronomical physics.

Campbell, W. W. (Chairman), 1924.	Abbot, C. G., 1921.	Michelson, A. A., 1922.
	Hale, G. E., 1923.	Russell, H. N., 1925.

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THE J. LAWRENCE SMITH FUND.

[$10,000.]

J. Lawrence Smith medal and investigations of meteoric bodies.

Cross, Whitman (Chairman), 1922. Adams, W. S., 1924. Dana, E. S., 1923.
Schlesinger, F., 1925. Wood, R. W., 1921.

THE BARNARD MEDAL.[1]

Meritorious service to science.

Noyes, A. A. (Chairman). Campbell, W. W. Nichols, E. F.
Morgan, T. H. Richards, T. W.

THE BENJAMIN APTHORP GOULD FUND.

[$20,000.]

Researches in astronomy.

Moulton, F. R. (Chairman). Barnard, E. E. Woodward, R. S.

THE WOLCOTT GIBBS FUND.

[$5,545.50.]

Chemical research.

Jackson, C. L. (Chairman). Richards, T. W. Smith, Edgar F.

THE COMSTOCK FUND.

[$12,406.02.]

Researches in electricity, magnetism, and radiant energy.

Nichols, E. L. (Chairman), 1923. Millikan, R. A., 1921. Whitney, W. R., 1924.
Carty, J. J., 1925. Webster, A. G., 1922.

THE MARSH FUND.

[$20,000.]

Original research in the natural sciences.

Merriam, J. C. (Chairman), 1922. (Bumstead, H. A.), 1923.
Schuchert, Charles, 1921.

THE AGASSIZ FUND.

[$50,000.]

General uses of the Academy.

THE MURRAY FUND.

[$6,000.]

Agassiz medal and contributions to oceanography.

Dall, W. H. (Chairman), 1921. Davis, W. M., 1922. Mayor, A. G., 1923.

THE MARCELLUS HARTLEY FUND.

[$1,200.]

Medal for eminence in the application of science to the public welfare.

Noyes, A. A. (Chairman), 1922. Stratton, S. W., 1922. Pupin, M. I., 1921.
Osborn, H. F., 1921. Welch, W. H., 1923.
Taylor, D. W., 1923.

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[1] Every five years the committee recommends the person whom they consider most deserving of the medal, and upon the approval of the Academy the name of the nominee is forwarded to the trustees of Columbia University, who administer the Barnard medal fund.
[2] Died Dec. 31, 1920.

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THE DANIEL GIRAUD ELLIOT FUND.

[$8,000.]

Medal and honorarium for most meritorious work in zoology or paleontology published in each year.

Osborn, H. F. (Chairman). [1] Lucas, F. A. Walcott, C. D.

THE MARY CLARK THOMPSON FUND.

[$10,000.]

Medal for most important services to geology and paleontology.

Clarke, J. M. (Chairman), 1922. Lindgren, W., 1923. Osborn, H. F., 1921.

THE JOSEPH HENRY FUND.

To assist meritorious investigators, especially in the direction of original research.

The sum of $40,000 was contributed by Fairman Rogers, Joseph Patterson, George W. Childs, and others, as an expression of their respect and esteem for Prof. Joseph Henry. This amount was deposited with the Pennsylvania Co. for the insurance of lives and granting annuities in trust, with authorization to collect the income thereon and to pay over the same to Prof. Joseph Henry during his natural life, and after his death to his wife and daughters, and after the death of the last survivor to "deliver the said fund and the securities in which it shall then be invested to the National Academy of Sciences, to be thenceforward forever held in trust under the name and title of the 'Joseph Henry fund.'"

[1] Not a member of the Academy.

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MEMBERS OF THE NATIONAL ACADEMY OF SCIENCES.

DECEMBER 31, 1920.

	Date of election.
Abbot, Charles Greeley, Smithsonian Institution, Washington, D. C	1915
Abbot, Henry L., U. S. Army, 23 Berkeley Street, Cambridge 38, Mass	1872
Abel, John Jacob, Johns Hopkins University, Baltimore, Md	1912
Adams, Walter Sydney, Solar Observatory Office, Pasadena, Calif	1917
Aitken, Robert Grant, Lick Observatory, Mount Hamilton, Calif	1918
Allen, J. Asaph, American Museum of Natural History, New York City	1876
Ames, Joseph S., Johns Hopkins University, Baltimore, Md	1909
Angell, James Rowland, Carnegie Corporation, New York City	1920
Armsby, Henry Prentiss, State College of Pennsylvania, Pa	1920
Bailey, Liberty Hyde, Ithaca, N. Y	1917
Bancroft, W. D., 7 East Avenue, Ithaca, N. Y	1920
Barnard, E. E., Yerkes Observatory, Williams Bay, Wis	1911
Barus, Carl, Brown University, Providence, R. I	1892
Baxter, Gregory Paul, T. J. Coolidge, jr., Memorial Laboratory, Cambridge, Mass.	1916
Bell, A. Graham, 1331 Connecticut Avenue, Washington, D. C	1883
Benedict, Francis Gano, Nutrition Laboratory, Boston 17, Mass	1914
Birkhoff, George David, Harvard University, Cambridge, Mass	1918
Blichfeldt, Hans Frederick, Stanford University, Calif	1920
Bliss, Gilbert Ames, University of Chicago, Chicago, Ill	1916
Boas, Franz, Columbia University, New York City	1900
Bogert, Marston Taylor, Columbia University, New York City	1916
Boltwood, B. B., Yale University, New Haven, Conn	1911
Bolza, Oskar, Reichsgrafenstr. 10, Freiburg, Germany	1909
Branner, John C., Stanford University, Calif	1905
Bridgman, Percy Williams, Jefferson Phys. Lab., Cambridge, Mass	1918
Britton, Nathaniel Lord, New York Botanical Gardens, New York City	1914
*Bumstead, Henry Andrews, Yale University, New Haven, Conn	1913
Calkins, Gary Nathan, Columbia University, New York City	1919
Campbell, D. H., Stanford University, Calif	1910
Campbell, William W., Lick Observatory, Mount Hamilton, Calif	1902
Cannon, Walter Bradford, Harvard University, Cambridge, Mass	1914
Carlson, Anton Julius, University of Chicago, Chicago, Ill	1920
Carty, John J., American Telegraph and Telephone Co., New York City	1917
Castle, William Ernest, 186 Payson Road, Belmont, Mass	1915
Cattell, James McK., Garrison, N. Y	1901
Chamberlin, Thomas C., University of Chicago, Chicago, Ill	1903
Chandler, Charles F., Columbia University, New York City	1874
Chittenden, Russell H., Sheffield Scientific School, New Haven, Conn	1890
Clarke, F. W., U. S. Geological Survey, Washington, D. C	1909
Clarke, J. M., State Museum, Albany, N. Y	1909
Comstock, George C., Washburn Observatory, Madison, Wis	1899

*Died Dec. 31, 1920.

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	Date of election.
Conklin, E. G., Princeton, N. J.	1908
Coulter, J. M., University of Chicago, Chicago, Ill.	1909
Councilman, William T., Harvard Medical School, Boston, Mass.	1904
Crew, Henry, Northwestern University, Evanston, Ill.	1909
Cross, Whitman, 2138 Bancroft Place, Washington, D. C.	1908
Curtis, Heber Doust, Allegheny Observatory, Pittsburgh, Pa.	1919
Cushing, Harvey, Harvard University, Cambridge, Mass.	1917
Dall, William H., Smithsonian Institution, Washington, D. C.	1897
Dana, Edward S., Yale University, New Haven, Conn.	1884
Davenport, Charles B., Cold Spring Harbor, N. Y.	1912
Davis, William Morris, 31 Hawthorn Street, Cambridge 38, Mass.	1904
Day, Arthur L., 2801 Upton Street, Washington, D. C.	1911
Dewey, John, Columbia University, New York City	1910
Dickson, Leonard E., University of Chicago, Chicago, Ill.	1913
Donaldson, Henry Herbert, Wistar Institute of Anatomy, Philadelphia, Pa.	1914
Duane, William, Harvard University Medical School, Cambridge, Mass.	1920
Dunn, Gano, 43 Exchange Place, New York City	1919
Durand, William Frederick, Leland Stanford University, Calif.	1917
Elkin, William L., Yale University Observatory, New Haven, Conn.	1895
Fewkes, Jesse Walter, Bureau of American Ethnology, Washington, D. C.	1914
Flexner, Simon, Rockefeller Institute, New York City	1906
Folin, Otto, Harvard Medical School, Boston, Mass.	1916
Forbes, Stephen Alfred, Urbana, Ill.	1916
Franklin, Edward Curtis, Stanford University, Calif.	1914
Freeman, John Ripley, Providence, R. I.	1915
Frost, Edwin B., Yerkes Observatory, Williams Bay, Wis.	1908
Gomberg, Moses, University of Michigan, Ann Arbor, Mich.	1914
Gooch, Frank A., 291 Edwards Street, New Haven, Conn.	1897
Goodale, George L., Harvard University, Cambridge, Mass.	1890
Hale, George E., Solar Observatory Office, Pasadena, Calif.	1902
Hall, Edwin H., Harvard University, Cambridge, Mass.	1911
Hall, Granville Stanley, Clark University, Worcester, Mass.	1915
Halsted, William Stewart, Johns Hopkins Medical School, Baltimore, Md.	1917
Harper, R. A., Columbia University, New York City	1911
Harrison, Ross G., Yale University, New Haven, Conn.	1915
Hastings, Charles S., Yale University, New Haven, Conn.	1889
Hayford, John F., Northwestern University, Evanston, Ill.	1917
Hektoen, Ludvig, 637 South Wood Street, Chicago, Ill.	1915
Henderson, Lawrence Joseph, Harvard University, Cambridge, Mass.	1919
Herrick, Charles Judson, University of Chicago, Chicago, Ill.	1916
Hillebrand, William F., Bureau of Standards, Washington, D. C.	1908
Holmes, William H., U. S. National Museum, Washington, D. C.	1905
Howard, Leland Ossian, U. S. Department of Agriculture, Washington, D. C.	1916
Howe, Henry Marion, Broad Brook Road, Bedford Hills, N. Y.	1917
Howell, William H., School of Hygiene and Public Health, Baltimore, Md.	1905
Hunt, Reid, Harvard Medical School, Boston, Mass.	1919
Jackson, Charles L., 383 Beacon Street, Boston, Mass.	1883
Jennings, Herbert Spencer, Johns Hopkins University, Baltimore, Md.	1914
Jewett, Frank Baldwin, Western Electric Co., New York, N. Y.	1916
Johnson, Treat Baldwin, Yale University, New Haven, Conn.	1916
Jones, Lewis Ralph, University of Wisconsin, Madison, Wis.	1920
Jones, Walter, Johns Hopkins University, Baltimore, Md.	1916

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	Date of election.
Kasner, Edward, Columbia University, New York City	1917
Kemp, James F., Columbia University, New York City	1911
Kohler, Elmer Peter, Harvard University, Cambridge, Mass	1920
Langmuir, Irving, General Electric Co., Schenectady, N. Y	1918
Leith, Charles Kenneth, University of Wisconsin, Madison, Wis	1920
Leuschner, Armin O., University of California, Berkeley, Calif	1913
Levene, Phœbus Aaron Theodor, Rockefeller Institute, New York City	1916
Lewis, Gilbert N., University of California, Berkeley, Calif	1913
Lillie, Frank Rattray, University of Chicago, Chicago, Ill	1915
Lindgren, Waldemar, Massachusetts Institute of Technology, Cambridge, Mass.	1909
Loeb, Jacques, Rockefeller Institute, New York City	1910
Lusk, Graham, Cornell University Medical College, New York City	1915
Lyman, Theodore, Harvard University, Cambridge, Mass	1917
McClung, Clarence E., Nat. Res. Council, 1701 Mass. Ave., Washington, D. C.	1920
McCollum, Elmer Vernon, Johns Hopkins Medical School, Baltimore, Md	1920
Mark, Edward L, 109 Irving Street, Cambridge, Mass	1903
Mayor, Alfred Goldsborough, 276 Nassau Street, Princeton, N. J	1916
Mendel, Lafayette B., Yale University, New Haven, Conn	1913
Mendenhall, Charles Elwood, University of Wisconsin, Madison, Wis	1918
Mendenhall, Thomas C., 329 North Chestnut Street, Ravenna, Ohio	1887
Merriam, C. Hart, 1919 Sixteenth Street, Washington, D. C	1902
Merriam, John Campbell, Carnegie Institution, Washington, D. C	1918
Merritt, Ernest, Cornell University, Ithaca, N. Y	1914
Michael, Arthur, 219 Parker Street, Newton Center, Mass	1889
Michelson, Albert A., University of Chicago, Chicago, Ill	1888
Millikan, Robert Andrews, University of Chicago, Chicago, Ill	1915
Moore, Eliakim H., University of Chicago, Chicago, Ill	1901
Morgan, T. H., Columbia University, New York City	1909
Morley, Edward W., West Hartford, Conn	1897
Morse, Edward S., Salem, Mass	1876
Moulton, F. R., University of Chicago, Chicago, Ill	1910
Nichols, Edward L., Cornell University, Ithaca, N. Y	1901
Nichols, Ernest F., Nela Research Laboratory, Nela Park, Cleveland, Ohio	1908
Noyes, Arthur A., California Institute of Technology, Pasadena, Calif	1905
Noyes, William A., University of Illinois, Urbana, Ill	1910
Osborn, H. F., American Museum of Natural History, New York City	1900
Osborne, T. B., Agricultural Experiment Station, New Haven, Conn	1910
Osgood, William Fogg, Harvard University, Cambridge, Mass	1904
Osterhout, Winthrop John Vanleuven, Harvard University, Cambridge, Mass.	1919
Parker, George H., 16 Berkeley Street, Cambridge, Mass	1913
Pearl, Raymond, 625 St. Paul Street, Baltimore, Md	1916
Pierce, George Washington, Harvard University, Cambridge, Mass	1920
Prudden, T. Mitchell, Columbia University, New York City	1901
Pumpelly, Raphael, Gibbs Avenue, Newport, R. I	1872
Pupin, Michael I., Columbia University, New York City	1905
Ransome, Frederick Leslie, U. S. Geol. Survey, Washington, D. C	1914
Reid, H. Fielding, Johns Hopkins University, Baltimore, Md	1912
Remsen, Ira, Johns Hopkins University, Baltimore, Md	1882
Richards, Theodore W., Wolcott Gibbs Memorial Laboratory, Cambridge, Mass.	1899
Ridgway, Robert, 1030 South Morgan Street, Olney, Ill	1917
Rosa, Edward B., Bureau of Standards, Washington, D. C	1913

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	Date of election.
Russell, Henry Norris, Princeton University, Princeton, N. J.	1918
Ryan, Harris Joseph, Stanford University, Stanford, Calif.	1920
Sargent, Charles S., Arnold Arboretum, Jamaica Plains, Mass.	1895
Schlesinger, Frank, Yale University Observatory, New Haven, Conn.	1916
Schuchert, Charles, Yale University, New Haven, Conn.	1910
Scott, William B., Princeton University, Princeton, N. J.	1906
Seares, Frederick Hanley, Mount Wilson Observatory, Pasadena, Calif.	1919
Setchell, William Albert, University of California, Berkeley, Calif.	1919
Smith, Alexander, Columbia University, New York City.	1915
Smith, Edgar F., University of Pennsylvania, Philadelphia, Pa.	1899
Smith, Erwin F., Bureau of Plant Industry, Washington, D. C.	1913
Smith, Theobald, Rockefeller Institute for Medical Research, Princeton, N. J.	1908
Squier, George Owen, Chief Signal Officer, U. S. Army, Washington, D. C.	1919
Stebbins, Joel, University of Illinois Observatory, Urbana, Ill.	1920
Stieglitz, Julius, University of Chicago, Chicago, Ill.	1911
Story, William E., Clark University, Worcester, Mass.	1908
Stratton, Samuel Wesley, Bureau of Standards, Washington, D. C.	1917
Taylor, David Watson, Department of the Navy, Washington, D. C.	1918
Thaxter, Roland, Harvard University, Cambridge, Mass.	1912
Thomson, Elihu, Swampscott, Mass.	1907
Thorndike, Edward Lee, Columbia University, New York City.	1917
Trelease, William, University of Illinois, Urbana, Ill.	1902
Trowbridge, Augustus, Princeton University, Princeton, N. J.	1919
Trowbridge, John, Harvard University, Cambridge, Mass.	1878
Ulrich, Edward Oscar, U. S. Geol. Survey, Washington, D. C.	1917
Van Vleck, E. B., University of Wisconsin, Madison, Wis.	1911
Vaughan, Victor Clarence, University of Michigan, Ann Arbor, Mich.	1915
Veblen, Oswald, Princeton University, Princeton, N. J.	1919
Verrill, A. E., 582 Central Ave., Westville, Conn	1872
Walcott, Charles D., Smithsonian Institution, Washington, D. C.	1896
Webster, Arthur G., Clark University, Worcester, Mass.	1903
Welch, William H., 807 St. Paul Street, Baltimore, Md.	1895
Wells, Horace L., Yale University, New Haven, Conn.	1903
Wheeler, William M., Harvard University, Cambridge, Mass.	1912
White, David, United States Geological Survey, Washington, D. C.	1912
White, Henry Seely, Vassar College, Poughkeepsie, N. Y.	1915
Whitney, Willis Rodney, General Electric Co., Schenectady, N. Y.	1917
Wilczynski, Ernest Julius, University of Chicago, Chicago, Ill.	1919
Willis, Bailey, Stanford University, Stanford, Calif.	1920
Wilson, Edmund B., Columbia University, New York City.	1899
Wilson, Edwin B., Massachusetts Institute of Technology, Cambridge, Mass.	1919
Wood, Robert W., Johns Hopkins University, Baltimore, Md.	1912
Woodward, Robert S., Carnegie Institution, Washington, D. C.	1896

HONORARY MEMBER.

Smith, Sidney I., Yale University, New Haven, Conn.	1884

FOREIGN ASSOCIATES.

Adams, Frank Dawson, McGill University, Montreal, Canada.	1920
Arrhenius, S. A., Nobelinstitut, Stockholm.	1908
Barrois, Charles, Université, Lille.	1908
Brøgger, W. C., Universitet, Christiania.	1903

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	Date of election.
De Vries, Hugo, Lunteren, Holland	1904
Deslandres, Henri, Astrophysical Observatory, Meudon	1913
Dewar, Sir James, University, Cambridge, England	1907
Forsyth, A. R., Imperial College of Science and Technology, London	1907
Geikie, Sir Archibald, Haslemere, Surrey	1901
Groth, Paul von, Universität, Munich	1905
Heim, Albert, Zürich	1913
Hilbert, David, Universität, Göttingen	1907
Jordan, Marie Ennemond Camille, College of France, Paris	1920
Kapteyn, John C., Rijks Universiteit, Groningen	1907
Klein, Felix, Universität, Göttingen	1898
Kössel, Albrecht, Heidelberg	1913
Küstner, Karl Friedrich, Bonn	1913
Lacroix, François Antoine Alfred, Musée d'Histoire Naturelle, Paris	1920
Lankester, Sir E. Ray, South Kensington, London	1903
Larmor, Sir Joseph, St. Johns College, Cambridge, England	1908
Lorentz, Hendrik Anton, Rijks Universiteit, Leiden	1906
Onnes, Heike Kammerlingh, University of Leiden, Leiden	1920
Ostwald, Wilhelm, Grossbothen bei Leipzig	1906
Pavlov, Ivan Petrovitch, Inst. for Experimental Medicine, Petrograd	1908
Penck, Albrecht, Universität, Berlin	1909
Picard, Charles Émile, Université, Paris	1903
Prain, Sir David, Royal Botanic Gardens, Kew, Surrey	1920
Ramon y Cajal, Santiago, University of Madrid, Madrid	1920
Rutherford, Sir Ernest, Newnham Cottage, Queen's Road, Cambridge, England	1911
Schuster, Sir Arthur, Yeldall, Twyford, Berkshire, England	1913
Seeliger, Hugo Ritter von, Universität, Munich	1908
Thomson, Sir Joseph, University, Cambridge, England	1903
Volterra, Vito, Università, Rome	1911
Van der Waals, Johannes D, Amsterdam	1913
Waldeyer, Wilhelm, Universität, Berlin	1909
Wolf, Max F. J. C., Heidelberg	1913

Deceased members.

	Date of election.	Date of death.		Date of election.	Date of death.
Abbe, Cleveland	1878	Oct. 28, 1916	Billings, John S	1883	Mar. 11, 1913
Agassiz, Alexander	1866	Mar. 27, 1910	Bôcher, Maxime	1909 [2]	Sept. 12, 1918
Agassiz, Louis	(1)	Dec. 14, 1873	Boss, Lewis	1889	Oct. 5, 1912
Atkinson, George Francis	1918 [2]	Nov. 14, 1918	Bowditch, Henry P	1887 [2]	Mar. 13, 1911
Alexander, J. H	(1)	Mar. 2, 1867	Brewer, William H	1880 [2]	Nov. 2, 1910
Alexander, Stephen	(1)	June 25, 1883	Brooks, William Keith	1884	Nov. 12, 1908
Bache, Alexander Dallas	(1)	Feb. 14, 1867	Brown-Sequard, Chas. E	1868	Apr. 2, 1894
Baird, Spencer F	1864	Aug. 19, 1887	Brush, George Jarvis	1868 [2]	Feb. 6, 1912
Barker, George F	1876 [2]	May 24, 1910	Bumstead, Henry A	1913 [2]	Dec. 31, 1920
Barnard, F. A. P	(1) (2)	Apr. 27, 1889	Case, Thomas L	1890	Mar. 25, 1896
Barnard, J. G	(1)	May 14, 1882	Caswell, Alexis	(1)	Jan. 8, 1877
Barrell, Joseph	1919 [2]	May 4, 1919	Chandler, Seth Carlo	1888 [2]	Dec. 31, 1913
Bartlett, W. H. C	(1)	Feb. 11, 1893	Chauvenet, William	(1)	Dec. 13, 1879
Becker, George Ferdinand	1901 [2]	Apr. 20, 1919	Clark, Henry James	1872	July 1, 1873
Beecher, Charles Emerson	1899	Feb. 14, 1904	Clark, William B	1908	July 27, 1917

[1] Charter members, Mar. 3, 1863. [2] Biographical memoirs have not been presented.

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Deceased members—Continued.

	Date of election.	Date of death.
Coffin, James H.	1869	Feb. 6, 1873
Coffin, J. H. C.	(1)	Jan. 8, 1890
Comstock, Cyrus B.	1884	May 29, 1910
Cook, George H.	1887	Sept. 22, 1889
Cooke, Josiah P.	1872	Sept. 3, 1894
Cope, Edward D.	1872 [2]	Apr. 12, 1897
Coues, Elliott	1877	Dec. 25, 1899
Crafts, James M.	1872	June 21, 1917
Dalton, J. C.	1864	Feb. 2, 1889
Dana, James D.	(1)	Apr. 14, 1895
Davidson, George	1874 [2]	Dec. 2, 1911
Davis, Charles H.	(1)	Feb. 18, 1877
Draper, Henry	1877	Nov. 20, 1882
Draper, John W.	1877	Jan. 4, 1882
Dutton, C. E.	1884 [2]	Jan. 4, 1912
Eads, James B.	1872	Mar. 8, 1887
Emmons, Samuel F.	1892	Mar. 28, 1911
Engelmann, George	(1)	Feb. 4, 1884
Farlow, W. G.	1879 [2]	June 3, 1919
Ferrel, William	1868	Sept. 18, 1891
Fraser, John Fries	(1)	Oct. 12, 1872
Gabb, William M.	1876	May 30, 1878
Genth, F. A.	1872	Feb. 2, 1893
Gibbs, Josiah Willard	1879	Apr. 28, 1903
Gibbs, Wolcott	(1)	Dec. 9, 1908
Gilbert, Grove Karl	1883 [2]	May 1, 1918
Gill, Theodore Nicholas	1873	Sept. 25, 1914
Gilliss, James Melville	(1)	Feb. 9, 1865
Goode, G. Brown	1888	Sept. 6, 1896
Gould, Augustus A.	(1)	Sept. 15, 1866
Gould, Benjamin A.	(1) (3)	Nov. 26, 1896
Gray, Asa	(1)	Jan. 30, 1888
Guyot, Arnold	(1)	Feb. 8, 1884
Hadley, James	1872	Nov. 14, 1872
Hague, Arnold	1885	May 15, 1917
Haldeman, S. S.	1876	Sept. 20, 1880
Hall, Asaph	1875	Nov. 22, 1907
Hall, James	(1) (3)	Aug. 7, 1898
Hayden, F. V.	1873	Dec. 22, 1887
Henry, Joseph	(1)	May 13, 1878
Hilgard, Eugene W.	1872	Jan. 8, 1916
Hilgard, Julius E.	(1)	May 9, 1890
Hill, George William	1874	Apr. 16, 1914
Hill, Henry B.	1883	Apr. 6, 1903
Hitchcock, Edward	(1)	Feb. 27, 1864
Holbrook, J. E.	1868	Sept. 8, 1871
Holden, EdwardSingleton	1885	Mar. 16, 1914
Hubbard, J. S.	(1)	Aug. 16, 1863
Humphreys, A. A.	(1)	Dec. 27, 1883
Hunt, T. Stery	1873 [2]	Feb. 12, 1892
Hyatt, Alpheus	1875	Jan. 15, 1902
Iddings, Joseph P.	1907 [2]	Sept. 8, 1920,
James, William [2]	1903	Aug. 26, 1910
Johnson, S. W.	1866	July 21, 1909
Keeler, J. E.	1900	Aug. 12, 1900
King, Clarence	1876	Dec. 24, 1901
Kirtland, Jared P.	1865	Dec. 10, 1877
Lane, J Homer	1872	May 3, 1899
Langley, Samuel P.	1876	Feb. 27, 1906
Lea, Matthew Carey	1892	Mar. 15, 1897
Le Conte, John	1878	Apr. 29, 1891
Le Conte, John L.	(1)	Nov. 15, 1883
Le Conte, Joseph	1875	July 6, 1901
Leidy, Joseph	(1)	Apr. 30, 1891
Lesley, J. Peter	(1)	June 1, 1903
Lesquereux, Leo	1864	Oct. 28, 1889
Lonsstreth, Miers F.	(4)	Dec. 27, 1891
Loomis, Elias	1873	Aug. 15, 1889
Loveriug, Joseph	1873	Jan. 18, 1892
Lyman, Theodore	1872	Sept. 9, 1897
Mahan, D. H.	(1)	Sept. 16, 1871
Mall, Franklin P.	1907 [2]	Nov. 17, 1917
Marsh, G. P.	1866	July 23, 1882
Marsh, O. C.	1874 [2]	Mar. 18, 1899
Mayer, Alfred M.	1872	July 13, 1897
Meek, F. B.	1869	Dec. 21, 1876
Meigs, M. C.	1865	Jan. 2, 1893
Meltzer, Samuel James	1912 [2]	Nov. 8, 1920
Minot, Charles Sedgwick	1897	Nov. 19, 1914
Mitchell, Henry	1885 [2]	Dec. 1, 1902
Mitchell, Silas Weir	1865	Jan. 4, 1914
Morgan, Lewis H.	1875	Dec. 17, 1881
Morse, Harmon N.	1907 [2]	Sept. 8, 1920
Morton, Henry	1874	May 9, 1902
Nef, John Ulric	1904 [2]	Aug. 13, 1915
Newberry, J. S.	(1)	Dec. 7, 1892
Newcomb, Simon	1869 [2]	July 11, 1909
Newton, H. A.	(1)	Aug 12, 1896
Newton, John	1876	May 1, 1895
Norton, William A.	1873	Sept. 21, 1883
Oliver, James E.	1872	Mar. 27, 1900
Packard, A. S.	1872	Feb. 14, 1905
Penfield, Samuel L.	1900	Aug. 12, 1905
Peters, C. H. F.	1876 [2]	July 18, 1880
Peirce, Benjamin [2]	(1)(3)	Oct. 6, 1880
Peirce, Benjamin Osgood	1906	Jan. 14, 1914
Pickering, Edward C.	1873 [2]	Feb. 3, 1919
Pierce, Charles S. S.	1876 [2]	Apr. 20, 1914
Pirsson, Louis V.	1913 [2]	Dec. 8, 1919
Pourtales, L. F.	1873	July 19, 1880
Powell, John W.	1880	Sept. 23, 1902
Putnam, Frederick W.	1885 [2]	Aug. 13, 1915
Rodgers, John	(1)	May 5, 1882
Rogers, Fairman	(1)	Aug. 22, 1883

[1] Charter members, Mar. 3, 1863.
[2] Biographical memoirs have not been presented
[3] Resigned in 1908 or 1909.

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Deceased members—Continued.

	Date of election.	Date of death.		Date of election.	Date of death.
Rogers, Robert E.[4]	(1)	Sept. 6, 1884	Trowbridge, William P.	1872	Aug. 12, 1892
Rogers, William A.	1885	Mar. 1, 1898	Trumbull, James H.	1872	Aug. 5, 1897
Rogers, William B.[5]	(1)	May 30, 1882	Tuckerman, Edward	1868	Mar. 15, 1886
Rood, Ogden N.	1865	Nov. 12, 1902	Van Hise, C. R.	1902 [2]	Nov. 19, 1918
Rowland, Henry A.	1881	Apr. 16, 1901	Walker, Francis A.	1878	Jan. 5, 1897
Royce, Josiah	1906 [2]	Sept. 14, 1916	Warren, G. K.	1876	Aug. 8, 1882
Rutherfurd, Lewis M.	(1)	May 30, 1892	Watson, James C.	1868	Nov. 23, 1880
Sabine, Wallace C. W.	1917 [2]	Jan. 10, 1919	Watson, Sereno	1889	Mar. 9, 1892
Saxton, Joseph	(1)	Oct. 26, 1873	Wheeler, Henry Lord	1909 [2]	Oct. 30, 1914
Schott, Charles A.	1872	July 31, 1901	White, Charles A.	1889	June 29, 1910
Scudder, Samuel H.	1877 [2]	May 17, 1911	Whitman, C. O.	1895	Dec. 6, 1910
Sellers, William	1873 [3]	Jan. 24, 1905	Whitney, Josiah D.[3]	(1)(3)	Aug. 19, 1896
Silliman, Benj., sr.	(1)	Nov. 24, 1864	Whitney, William D.[3]	1865 [3]	June 29, 1894
Silliman, Benj., jr.	(1)	Jan. 14, 1885	Williston, Samuel W.	1915 [5]	Aug. 30, 1918
Smith, J. Lawrence	1872	Oct. 12, 1883	Winlock, Joseph	(1)	June 11, 1875
Smith, Richmond Mayo	1890 [2]	Nov. 11, 1901	Wood, Horatio C.	1879 [2]	Jan. 3, 1920
Stimpson, William	1868	May 26, 1872	Woodward, J. J.	1873	Aug. 17, 1884
Strong, Theodore	(1)	Feb. 1, 1869	Worthen, A. H.	1872	May 6, 1888
Sullivant, W. S.	1872	Apr. 30, 1873	Wright, Arthur Williams.	1881 [2]	Dec. 19, 1915
Torrey, John	(1)	Mar. 10, 1873	Wyman, Jeffries	(1)	Sept. 4, 1874
Totten, J. G.	(1)	Apr. 22, 1864	Young, Charles A.	1872	Jan. 3, 1908

[1] Charter members, Mar. 3, 1863.
[2] Biographical memoirs have not been presented.
[3] Resigned 1873.
[4] Dropped —, reelected 1875.
[5] Dropped —, reelected 1872.
[6] Resigned.

DECEASED FOREIGN ASSOCIATES.

Adams, J. C.
Airy, Sir George B.
Argelander, F. W. A.
Auwers, G. F. J. Arthur
Backlund, Oskar
Baer, Karl Ernest von
Baeyer, Adolf von
Barrande, Joachin
Beaumont, L. Élie de
Becquerel, Henri
Berthelot, M. P. E.
Bertrand, J. L. F.
Boltzmann, Ludwig
Bornet, Edouard
Boussingault, J. B. J. D.
Boveri, Theodor
Braun, Alexander
Brewster, Sir David
Bunsen, Robert W.
Burmeister, C. H. C.
Candolle, Alphonse de
Cayley, Arthur
Chasles, Michel
Chevreul, M. E.
Clausius, Rudolph
Cornu, Alfred
Crookes, Sir William
Darboux, Gaston
Darwin, Sir George Howard
Dove, H. W.
Dumas, J. B.
Ehrlich, Paul
Faraday, Michael
Fischer, Emil
Gegenbaur, Karl
Glydén, Hugo
Gill, Sir David
Hamilton, Sir William Rowan
Helmholtz, Baron H. von
Hoff, J. H. van't
Hofmann, A. W.
Hooker, Sir Joseph D.
Huggins, Sir William
Huxley, T. H.
Ibañez, Carlos
Janssen, J.
Joule, James P.
Kekulé, August
Kelvin, Lord
Kirchoff, G. R.
Koch, Robert
Kölliker, Albert von
Kohlrausch, Friedrich
Kronecker, Hugo
Lacaze-Duthiers, Henri de
Leuckart, Rudolph
Lie, Sophus
Liebig, Justus von

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Lister, Lord
Loewy, Maurice
Ludwig, K. F. W.
Marey, E. J.
Mendeléeff, D. I.
Milne-Edwards, Henri
Moissan, Henri
Murchison, Sir Roderick I.
Murray, Sir John
Oppolzer, Theodore von
Owen, Sir Richard
Pasteur, Louis
Peters, C. A. F.
Pfeffer, Wilhelm
Plana, G. A. A.
Poincaré, Jules Henri
Rammelsberg, C. F.
Ramsay, Sir William
Rayleigh, Lord
Regnault, Victor
Retzius, Gustav
Reymond, Emil Du Bois
Richthofen, F. von
Rosenbusch, Karl Harry Ferdinand
Sachs, Julius von
Schiaparelli, Giovanni
Stas, Jean Servais
Stokes, Sir George G.
Strasburger, Edouard
Struve, Otto von
Suess, Eduard
Sylvester, J. J.
Tisserand, F. F.
Virchow, Rudolph von
Vogel, H. C.
Weierstrass, Karl
Weismann, August
Wöhler, Friedrich
Wundt, Wilhelm
Würtz, Adolph
Zirkel, Ferdinand
Zittell, K. A. R. von

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REPORT

OF THE

NATIONAL ACADEMY OF SCIENCES

FOR THE YEAR

1921

WASHINGTON
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1922

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REPORT

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FOR THE YEAR

1921

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1922

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REPORT

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CONTENTS.

	Page
Letter of transmittal	VII
Act of incorporation	VIII
Amendments	IX
Meetings of the National Academy of Sciences	1
Annual meeting	1
Members in attendance	1
Business sessions	2
Announcement of death	2
Changes in personnel of sections and committees	2
Delegates	2
Report of the treasurer	2
Report of the home secretary	2
Research funds	3
Joseph Henry fund	3
Report of the directors of the Bache fund	4
Report of the trustees of the Watson fund	5
Report of the directors of the Wolcott Gibbs fund	6
Report of the committee of the Henry Draper fund	7
Report of the directors of the Gould fund	7
Report of the committee on the Comstock fund	8
Report of the committee on the Elliot fund	8
Report of the committee on the Marsh fund	8
Report of the committee on the Mary Clark Thompson fund	9
Building plans	9
Recommendations from the council	9
Amendment to rules	10
Humanistic science	10
Conservation of natural resources	12
Publications for scientific men in Russia	13
National Research Council	13
Amendment to organization	13
Resignations	13
Charles D. Walcott	13
George E. Hale	14
Election of officers and members	15
Scientific sessions	16
April 25	16
April 26	16
Presentation of medals	17
Agassiz gold medal	17
Agassiz medal, 1920	17
Henry Draper medal	17
Daniel Giraud Elliott medal	17

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Meetings of the National Academy of Sciences—Continued.
Annual meeting—Continued.
Presentation of medals—Continued. Page.
Public-welfare medal 17
Mary Clark Thompson medal 17
Report of the National Research Council, January 1 to June 30, 1921 18
Introduction 18
Chairman and vice chairmen 18
Proceedings of the National Academy of Sciences 18
American Geophysical Union 19
Sigma XI 19
Committee on natural resources 19
Publications 19
Bulletin of the National Research Council 19
Reprint and circular series 20
Chemical exhibit and lecture 20
International dues 21
New building 21
Reports of divisions 21
Divisions of general relations 21
Division of Federal relations 21
Division of foreign relations 22
Division of States relations 24
Division of educational relations 24
Division of research extension 26
Research information service 29
Divisions of science and technology 32
Division of physical sciences 32
Division of engineering 34
Division of chemistry and chemical technology 40
Division of geology and geography 43
Division of medical sciences 45
Division of biology and agriculture 46
Division of anthropology and psychology 50
Appendix A 51
Officers, members, and committees 51
Divisions of the council 54
Division of Federal relations 54
Division of foreign relations 56
Division of States relations 58
Division of educational relations 59
Division of research extension 60
Research information service 62
Division of physical sciences 63
Division of engineering 65
Division of chemistry and chemical technology 68
Division of geology and geography 70
Division of medical sciences 71
Division of biology and agriculture 73
Division of anthropology and psychology 75
Research fellowship board 77
Appendix B 78
Articles of organization 78

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Page.
Annual report of the treasurer, January 1 to June 30, 1921 82
General review of financial transactions 82
National Academy of Sciences 82
Trust funds of the Academy 83
Statement of assets and liabilities 84
Statement of receipts and expenditures 87
Accounts with individual funds 89
National Research Council 93
Receipts and disbursements 94
Report of the auditing committee 97
Deceased members 98
Henry Andrews Bumstead 98
Edward Bennett Rosa 99
Appendixes 103
Appendix A—Constitution of the National Academy of Sciences 105
Appendix B—Rules 112
Appendix C—Organization of the Academy, 1921 119
Sections 119
Standing committees 121
Trust funds 122
Members of the National Academy of Sciences, June 30, 1921 124
Honorary member 128
Foreign associates 128
Deceased members 129
Deceased foreign associates 131

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LETTER OF TRANSMITTAL.

NATIONAL ACADEMY OF SCIENCES,
Washington, D. C., January 20, 1922.

SIR: I have the honor to transmit to you herewith the report of the president of the National Academy of Sciences for the last half of the fiscal year ended June 30, 1921.

Very respectfully,

CHARLES D. WALCOTT,
President.

Hon. CALVIN COOLIDGE,
Vice President of the United States.

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ACT OF INCORPORATION.

AN ACT To incorporate the National Academy of Sciences.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That Louis Agassiz, Massachusetts; J. H. Alexander, Maryland; S. Alexander, New Jersey; A. D. Bache, at large; F. B. Barnard,[1] at large; J. G. Barnard, United States Army, Massachusetts; W. H. C. Bartlett, United States Military Academy, Missouri; U. A. Boyden,[2] Massachusetts; Alexis Caswell, Rhode Island; William Chauvenet, Missouri; J. H. C. Coffin, United States Naval Academy, Maine; J. A. Dahlgren,[2] United States Navy, Pennsylvania; J. D. Dana, Connecticut; Charles H. Davis, United States Navy, Massachusetts; George Englemann, Saint Louis, Missouri; J. F. Frazer, Pennsylvania; Wolcott Gibbs, New York; J. M. Giles,[3] United States Navy, District of Columbia; A. A. Gould, Massachusetts; B. A. Gould, Massachusetts; Asa Gray, Massachusetts; A. Guyot, New Jersey; James Hall, New York; Joseph Henry, at large; J. E. Hilgard, at large, Illinois; Edward Hitchcock, Massachusetts; J. S. Hubbard, United States Naval Observatory, Connecticut; A. A. Humphreys, United States Army, Pennsylvania; J. L. Le Conte, United States Army, Pennsylvania; J. Leidy, Pennsylvania; J. P. Lesley, Pennsylvania; M. F. Longstreth, Pennsylvania; D. H. Mahan, United States Military Academy, Virginia; J. S. Newberry, Ohio; H. A. Newton, Connecticut; Benjamin Peirce, Massachusetts; John Rodgers, United States Navy, Indiana; Fairman Rogers, Pennsylvania; R. E. Rogers, Pennsylvania; W. B. Rogers, Massachusetts; L. M. Rutherford, New York; Joseph Saxton, at large; Benjamin Silliman, Connecticut; Benjamin Silliman, junior, Connecticut; Theodore Strong, New Jersey; John Torrey, New York; J. G. Totten, United States Army, Connecticut; Joseph Winlock, United States Nautical Almanac, Kentucky; Jeffries Wyman, Massachusetts; J. D. Whitney, California; their associates and successors duly chosen, are hereby incorporated, constituted, and declared to be a body corporate, by the name of the National Academy of Sciences.

SEC. 2. *And be it further enacted*, That the National Academy of Sciences shall consist of not more than fifty ordinary members, and the said corporation hereby constituted shall have power to make its

[1] The official list of members gives the name of F. A. P. Barnard.
[2] Declined.
[3] The official list of members gives the name of J. M. Gillis.

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own organization, including its constitution, by-laws, and rules and regulations; to fill all vacancies created by death, resignation, or otherwise; to provide for the election of foreign and domestic members, the division into classes, and all other matters needful or usual in such institution, and to report the same to Congress.

SEC. 3. *And be it further enacted*, That the National Academy of Sciences shall hold an annual meeting at such place in the United States as may be designated, and the Academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art, the actual expense of such investigations, examinations, experiments, and reports to be paid from appropriations which may be made for the purpose, but the Academy shall receive no compensation whatever for any services to the Government of the United States.

SOLOMON FOOTE,
President of the Senate pro tempore.
GALUSHA A. GROW,
Speaker of the House of Representatives.

Approved, March 3, 1863.
ABRAHAM LINCOLN, *President.*

AMENDMENTS.

AN ACT To amend the act to incorporate the National Academy of Sciences.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the act to incorporate the National Academy of Sciences, approved March third, eighteen hundred and sixty-three, be, and the same is hereby, so amended as to remove the limitation of the number of ordinary members of said Academy as provided in said act.

Approved, July 14, 1870.

AN ACT To authorize the National Academy of Sciences to receive and hold trust funds for the promotion of science, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the National Academy of Sciences, incorporated by the act of Congress, approved March third, eighteen hundred and sixty-three, and its several supplements, be, and the same is hereby, authorized and empowered to receive bequests and donations and hold the same in trust, to be applied by the said Academy in aid of scientific investigations and according to the will of the donors.

Approved, June 20, 1884.

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AN ACT To amend the act authorizing the National Academy of Sciences to receive and hold trust funds for the promotion of science, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the act to authorize the National Academy of Sciences to receive and hold trust funds for the promotion of science, and for other purposes, approved June twentieth, eighteen hundred and eighty-four, be, and the same is hereby, amended to read as follows:

"That the National Academy of Sciences, incorporated by the act of Congress approved March third, eighteen hundred and sixty-three, be, and the same is hereby, authorized and empowered to receive, by devise, bequest, donation, or otherwise, either real or personal property, and to hold the same absolutely or in trust, and to invest, reinvest, and manage the same in accordance with the provisions of its constitution, and to apply said property and the income arising therefrom to the objects of its creation and according to the instructions of the donors: *Provided, however*, That the Congress may at any time limit the amount of real estate which may be acquired and the length of time the same may be held by said National Academy of Sciences."

SEC. 2. That the right to alter, amend, or repeal this act is hereby expressly reserved.

Approved, May 27, 1914.

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ANNUAL REPORT OF THE NATIONAL ACADEMY OF SCIENCES.

MEETINGS OF THE NATIONAL ACADEMY.

ANNUAL MEETING.

The annual meeting of the Academy was held at the Smithsonian Institution in Washington, April 25, 26, and 27, 1921.

Eighty-one members and one foreign associate were present, as follows:

MEMBERS.

Abbot, Charles G.	Fewkes, J. Walter	Millikan, R. A.
Abel, John J.	Flexner, Simon	Moulton, F. R.
Adams, Walter S.	Freeman, John R.	Nichols, E. F.
Aitken, Robert G.	Hale, George E.	Noyes, Wm. A.
Ames, Joseph S.	Hall, Edwin H.	Osborn, H. F.
Angell, James R.	Harper, R. A.	Osborne, T. B.
Armsby, Henry P.	Holmes, W. H.	Pearl, Raymond
Bell, A. Graham	Howard, L. O.	Ransome, F. L.
Benedict, F. G.	Howe, Henry M.	Reid, H. Fielding
Birkhoff, G. D.	Howell, W. H.	Rosa, Edward B.
Boas, Franz	Hunt, Reid	Schlesinger, Frank
Bridgman, P. W.	Jennings, H. S.	Schuchert, Charles
Carty, John J.	Jones, Lewis R.	Setchell, Wm. A.
Cattell, J. McK.	Kemp, James F.	Smith, Erwin F.
Clarke, F. W.	Kohler, E. P.	Stebbins, Joel
Clarke, J. M.	Leith, C. K.	Stieglitz, Julius
Cross, Whitman	Lewis, G. N.	Stratton, S. W.
Curtis, H. D.	Lillie, F. R.	Taylor, D. W.
Dall, William H.	Lusk, Graham	Trowbridge, Augustus
Davenport, C. B.	McClung, C. E.	Ulrich, Edward O.
Davis, Wm. M.	McCollum, E. V.	Veblen, Oswald
Day, Arthur L.	Mark, Edward L.	Walcott, Charles D.
Dickson, L. E.	Mendel, L. B.	Webster, Arthur G.
Donaldson, H. H.	Mendenhall, C. E.	Welch, William H.
Duane, William	Merriam, C. H.	White, David
Dunn, Gano	Merriam, J. C.	Wilson, E. B.
Durand, Wm. F.	Merritt, Ernest	Woodward, R. S.

FOREIGN ASSOCIATE.

Adams, Frank Dawson

The National Academy of Sciences at the autumn meeting preceeding the annual meeting included in this report took final action in the changing of the fiscal year of the Academy from the calendar year to correspond with the fiscal year of the United States Government. This action was taken in view of the increased activities on account of the work of the National Research Council, which had

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changed its fiscal year. This report is for the period from January 1, 1921, to June 30, 1921, and each of the succeeding reports will be from July 1 to June 30 of the following year.

BUSINESS SESSIONS.

The annual report of the president, containing that of the treasurer for the calendar year 1920, in printed form, was presented, accepted, and distributed to members.

ANNOUNCEMENT OF DEATH.

Henry Andrews Bumstead, elected 1913, died December 31, 1920, biography assigned to B. B. Boltwood.

APPOINTMENTS TO SECTIONS AND COMMITTEES.

Sections.—Augustus Trowbridge, acting chairman of the section of physics, to succeed H. A. Bumstead, deceased, term expiring 1923. Arthur L. Day to succeed John M. Clarke as chairman of the section of geology and palaeontology, term expiring 1924. L. H. Bailey to succeed Erwin F. Smith as chairman of the section of botany, term expiring 1924.

Committees.—Henry Draper fund: C. G. Abbot to succeed himself, term expiring 1926.

J. Lawrence Smith fund: F. W. Clarke to succeed R. W. Wood, term expiring 1926.

Comstock fund: R. A. Millikan to succeed himself, term expiring 1926.

Marsh fund: Charles Schuchert to succeed himself, term expiring 1924; John M. Clarke to succeed H. A. Bumstead, term expiring 1923.

Murray fund: William H. Dall to succeed himself as chairman and member, term expiring 1924.

Marcellus Hartley fund: H. F. Osborn and M. I. Pupin, each to succeed himself, terms expiring 1924.

Mary Clark Thompson fund: H. F. Osborn to succeed himself, term expiring 1924.

Auditing committee: Arthur L. Day, Whitman Cross, L. O. Howard.

Tellers to count preference ballot: J. M. Clarke, Whitman Cross, Charles B. Davenport.

Delegates.—T. C. Mendenhall to semicentennial of the Ohio State University, October 13 and 14, 1920. Rear Admiral David W. Taylor, United States Navy, to centennial of the University of Virginia, May 31 to June 3, 1921. H. H. Donaldson, W. M. Davis, and Edgar F. Smith, to the annual meeting of the American Academy of Political and Social Science, Philadelphia, May 13 and 14, 1921. E. B. Van Vleck to the inauguration of Lotus Delta Coffman as president of the University of Minnesota, May 13, 1921.

REPORT OF THE TREASURER.

The report of the treasurer was presented in printed form and approved.

REPORT OF THE HOME SECRETARY.

The home secretary presented the following report, which was accepted:

The PRESIDENT OF THE NATIONAL ACADEMY OF SCIENCES.

SIR: I have the honor to present the following report of the publications and membership of the National Academy of Sciences for the year ending April 25, 1921.

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Of the Memoirs of the National Academy of Sciences, volume 14, fifth memoir, Tables of the Exponential Function and of the Circular Sine and Cosine to Radian Argument, by C. E. Van Orstrand, has been completed and distributed. The third memoir of volume 14, Tables of the Minor Planets, by A. O. Leuschner, A. E. Glancy, and S. H. Levy, is now in page proof and will be issued at an early date.

Volume 15 is complete in three parts, all of which are devoted by Psychological Examining in the United States Army, edited by Robert M. Yerkes. This memoir has gone in for final printing and is expected to be issued in a few days. This is also true of the first three memoirs of volume 16, Lower California and its Natural Resources, by E. W. Nelson, first memoir; Studies upon the Life Cycles of the Bacteria, by F. Löhnis, second memoir; and A Recalculation of the Atomic Weights, by F. W. Clarke, third memoir. All of these are expected to be issued and distributed within a short time.

No biographical memoirs have been published since the last annual meeting, as the funds for this purpose were exhausted. Manuscripts for the following biographies are now in the hands of the Home Secretary, and notwithstanding the present lack of funds and discouraging industrial conditions it is hoped that at least a few may be sent in for printing at an early date: Simon Newcomb, by W. W. Campbell, bibliography by R. C. Archibald; Richmond Mayo-Smith, by Edwin R. A. Seligman; Samuel Hubbard Scudder, by Alfred G. Mayor; Samuel Wendell Williston, by Richard S. Lull; George Jarvis Brush, by Edward S. Dana; and Charles Richard Van Hise, by T. C. Chamberlin.

Manuscript for The Tectonic Conditions Accompanying the Intrusion of Basic and Ultrabasic Igneous Rocks, by W. N. Benson, to be published as an academy memoir, is in the hands of the home secretary, awaiting more favorable printing conditions, as are also The Vegetation of the Alpine Region of the Rocky Mountains in Colorado, by Theodore Holm; Osteology of the Reptiles, by S. W. Williston; and American Oaks, by William Trelease.

Publication of the report of the committee of the National Academy of Sciences on the Panama Canal slides has been approved by the President of the United States and is now in the hands of the committee for examination before being sent to the printer.

Since the last meeting I have to report the death of one member; Henry Andrews Bumstead, died December 31, 1920. This leaves an active membership of 186 members, 1 honorary member, and 36 foreign associates.

C. G. ABBOT, *Home Secretary.*

RESEARCH FUNDS.

THE JOSEPH HENRY FUND.

The following recommendation from the council regarding the Joseph Henry fund was approved:

That as the death of Miss Caroline Henry on November 10, 1920, has removed the last surviving heir of Joseph Henry to the income of the Joseph Henry fund, the president be authorized, after he is satisfied as to the status of the fund, to approve the account of the Pennsylvania Co. for insurances on lives and granting of annuities rendered January 13, 1921, and execute the accompanying release to that company as trustee of the Joseph Henry Fund under deed by Joseph Patterson, George W. Childs, and Fairman Rogers, dated June 3, 1878, held by that company in trust to pay over the income to Harriet A. Henry, Mary A. Henry, Helen L. Henry, and Caroline Henry, and after the death of

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the last survivor, the principal to the National Academy of Sciences, and that the academy accept the bonds as listed and cash for the mortgages at their face values.

The president was authorized to appoint a committee of five to administer the trust fund known as the Joseph Henry fund, and appointed as members of this committee W. F. Durand, chairman; Arthur L. Day, J. C. Merriam, Charles B. Davenport, and C. E. McClung.

REPORT OF THE DIRECTORS OF THE BACHE FUND.

Since the annual meeting of the academy in April, 1919, the following grants have been made:

No. 222. C. H. Warren, Massachusetts Institute of Technology, Cambridge, Mass., $500. To defray expense of chemical analysis in the study of igneous rocks from Massachusetts.

No. 223. W. Lindgren, Massachusetts Institute of Technology, Cambridge, Mass., $500. For chemical analyses of samples used in a study of additions and losses that limestones (from Bingham, Utah) have suffered in contact metamorphism.

No. 224. T. H. Goodspeed, University of California, Berkeley, Calif., $500. For photographic records and illustration, over a period of three years, for a study of Nicotiana in respect to Mendelian inheritance, of quantitative inheritance, of inheritance of inter-specific hybrids, and of the nature of bud variation.

No. 225. Frank P. Underhill and L. B. Mendel, Yale University, New Haven, Conn., $1,000. For investigations on deficiencies in nutrition.

No. 226. Gilbert N. Lewis, University of California, Berkeley, Calif., $500. For the computation of chemical constants.

No. 227. H. W. Norris, Grinnell College, Grinnell, Iowa, $300. (1) For the investigation of the nervous system of the Elasmo branch fishes; (2) for the study of the Ganoid fishes.

No. 228. Preston Edwards, Laboratory of Physics, Johns Hopkins University, Baltimore, Md., $750. For investigations in acoustics.

The directors of the Bache fund have voted to transfer to capital $1,000 of the accumulated income, which brings the capital of the fund to $80,000.

The above grants practically exhaust the income available until about September, 1921, when the income will begin to exceed the requirements for grants thus made.

The undersigned resigns as a director of the fund on April 27, 1921, at the close of the annual meeting.

E. B. FROST, *Chairman.*

Reports of previous grants have been received as follows:

Nos. 192–203. The researches on igneous rocks of our fellow member of the academy, Prof. J. P. Iddings, have been ended by his untimely death. The chemical analyses had been completed for him, however, and the thin sections were prepared and are now at the National Museum. It is presumably quite feasible for the research to be continued by some other expert. The petrographic microscope bought from the grant has been deposited with the home secretary.

No. 193. Charles A. Kofoid, University of California. The work is in progress, one section being nearly ready for final MS.

No. 211. George H. Shull, Princeton University. The appropriation prevented the interruption of the genetical investigations, which are still in progress. The results have not yet been published.

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No. 212. Arthur G. Webster, Clark University. An introductory report was read at the meeting of the academy in 1920; another in preparation.

No. 213. D. S. Johnson, Johns Hopkins University. Sections are being made and studied of the Jamaican liverworts. Results promise to be important, not yet published.

No. 214. Carl H. Eigenmann, University of Indiana. Results published in Memoirs of the Museum of Comparative Zoology, Harvard, vol. 43, parts 1 and 2.

No. 215. H. W. Norris, Grinnell College. The nerves of Amia and Lepidosteus have been worked out and plotted in detail; many drawings, complete for publication.

No. 216. Asa A. Schaeffer, Knoxville, Tenn. Preliminary note published in Anatomical Record, vol. 20, p. 184, 1921. Research is still in progress, but delayed by difficulty in purchasing apparatus.

No. 217. J. C. Jensen, University Place, Nebr. Research delayed by difficulty in securing apparatus, but still in progress.

No. 218. H. Nort, Gouda, Holland. The counts have been completed of the stars on the Franklin-Adams charts in the northern milky way between +10° and −10° of galactic latitude, and first list of suspected variable stars has been sent for publication. An additional grant is desired.

No. 219. H. G. Barbour, Yale School of Medicine. Preliminary results have been published in Proceedings of the National Academy of Sciences and the Proceedings of the Society for Experimental Biology and Medicine. The research is near conclusion.

No. 220 (supplementing No. 214). With this grant Dr. William Ray Allen was sent to Lima, Peru, whence he crossed the Andes in making his collections of fishes. Publications have been made in several places of the results of these explorations, of which only a small part of the cost was paid by the grant from the Bache fund.

No. 221. William Bowie, United States Coast and Geodetic Survey. The grant was not used in 1920, as Congress made a small appropriation for maintaining the International Latitude Observatory at Ukiah, Calif. It will probably be needed during May and June, 1921.

No. 222. C. H. Warren, Massachusetts Institute of Technology. The research on pigmatite and fine granites of Cape Ann is in progress. Five analyses of rocks are completed and the microscopic and field study nearly finished and probably will be ready for publication in the summer.

No. 223. W. Lindgren, Massachusetts Institute of Technology. Eight analyses of rocks have been completed and research is in progress.

No. 224. T. H. Goodspeed, University of California. Research is in progress and data are being accumulated.

Report received and recommendations approved.

REPORT OF THE TRUSTEES OF THE WATSON FUND.

The trustees of the Watson fund recommend that an additional grant of $500 from the Watson fund be made to Prof. John A. Miller, of Swarthmore College, for the continuation of his investigation of parallaxes. Previous grants have been used in paying part of the salary of an assistant who has devoted her time to observing at the telescope and measuring parallax plates and making computations for them. The parallaxes of 50 additional stars are ready to go to press.

An additional grant of $300 to aid Prof. Herbert C. Wilson, of Carleton College, Northfield, Minn., in the determination of photographic positions of the Watson asteroids and of certain other minor planets, is recommended.

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Mr. Wilson has furnished many valuable positions for the testing and improving of the tables of the Watson asteroids. Support of his work was temporarily discontinued last year, in anticipation of the adoption of an international program of observation by the International Astronomical Union. For theoretical purposes, it seems important, however, to secure in the near future observations of some of the Watson asteroids as well as of other theoretically important minor planets.

The condition of the fund as of March 31, 1921, is as follows:

Uninvested income	$643.85
Invested income	1,780.00
Uninvested capital	23.75
Invested capital	24,976.25

A. O. LEUSCHNER, *Chairman.*

Report received and recommendations approved.

REPORT OF THE DIRECTORS OF THE WOLCOTT GIBBS FUND.

After their last report had been presented to the academy, the directors of the Wolcott Gibbs fund for chemical research received from Prof. R. L. Datta, University College of Science, Calcutta, an account of his work under grant 8 on the replacement of sulphonic groups by halogens. The paper on this subject by him and J. C. Bhownik, now ready for publication, contains painstaking studies of 34 compounds, which show that in many cases the results are better than those obtained by the ordinary methods. Grant 8 is now closed.

During the past year two appropriations have been made: Grant 9—$500 to Prof. W. D. Harkins, of Chicago University, for the construction of an accurate positive ray apparatus to be used in determining atomic weights in the search for isotopes of the elements. In his annual report Prof. Harkins states that the first steps have been taken in this work. Grant 10—$300 to Prof. R. L. Datta, University College of Science, Calcutta, to provide material for his researches on the temperature of explosion of endothermic substances. One hundred dollars of this grant has been sent to him already, the remaining $200 will follow, when a sufficient amount of income from the fund has been accumulated.

The following reports have been received of work under the grants not yet closed:

Grant 4 (for potentiometer). Prof. Harkins was allowed by vote of the directors to transfer the unexpended balance of his grant, $92, to grant 9, and grant 4 is closed after yielding three excellent papers already reported.

Grant 7 (for air pumps). Prof. Harkins reports that three papers have been published under this grant. The properties of subsidiary valance groups: I. The molecular volume relationships of the hydrates and ammines of some cobalt compounds. II. Subsidiary group mobility as studied by the heat decomposition of some cobalt ammines. By Clark, Quick, and Harkins, Journal of the American Chemical Society, 42: 2483–98 (1920). An apparent high pressure due to adsorption, the heat of adsorption, and the density of gas mask charcoals. By W. D. Harkins and D. T. Ewing. Proceedings, National Academy of Sciences, 6: 49–56 (1920.

Grant 6 (for atomic weight researches). Prof. Baxter, of Harvard University, reports progress on the different lines of work undertaken as follows:

I. The Atomic Weight of Cadmium. The paper on this subject with C. H. Wilson has been sent to the Journal of the American Chemical Society.

II. Impurities of Silver and Iodine. The paper on this subject is essentially ready for publication, but has been delayed in order that it may appear with

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the others, which take up the criticisms of Prof. P. A. Guye upon the Harvard methods of determining atomic weights.

III. Atomic Weight of Arsenic. It is hoped that the work with Prof. Yontz on this subject, interrupted by the war, will be finished in the coming summer. Meanwhile Mr. Dorcas is studying the preparation and analysis of arsenious chloride.

IV. Atomic Weight of Mercury. Dr. H. E. Wells has continued the work on mercuric chloride begun by Kobayaski. The results confirm the present accepted value for mercury.

V. Atomic Weights of Silicon and Boron. A Gaede vacuum pump has been bought (leaving a balance of only $4.01). This has proved so effective that there is a good prospect of finishing the work on boron silicon and arsenic in the coming year.

The bursar reports that the unexpended income of the fund on March 31, 1921, amounted to $500 invested and $170.88 uninvested. This latter sum is covered by grant 10.

C. L. JACKSON.
EDGAR F. SMITH.
T. W. RICHARDS.

Report received and recommendation approved.

REPORT OF THE HENRY DRAPER COMMITTEE.

The Draper Committee has unanimously recommended that the Draper gold medal be awarded to Dr. Pieter Zeeman, professor of physics in Amsterdam University, for his discovery of the so-called Zeeman effect and for its applications to researches in magneto-optics, and this recommendation has been confirmed by the academy. The reasons governing the recommendation are set forth in an attached statement.

No awards from the Draper fund have been made in the current year. The financial condition of the fund on March 31, 1921, was as follows:

Invested capital	$10,000.00
Invested income	917.50
Uninvested income	735.99

The sum available for the promotion of research was $1,653.49.

W. W. CAMPBELL, *Chairman.*

April 19, 1921.

Report received and recommendation approved.

REPORT OF THE DIRECTORS OF THE GOULD FUND.

The only grant from the fund during the current year is one for $1,000 to Mr. Benjamin Boss for the support of the Astronomical Journal. In the deed of gift Dr. Gould expressed the desire that the Astronomical Journal be supported from this fund, so far as is necessary.

The condition of the fund is at present as follows:

Invested capital	$19,992.50
Uninvested capital	7.50
Invested income	7,010.00
Uninvested income	232.16

F. R. MOULTON.
E. E. BARNARD.
R. S. WOODWARD.

Report received.

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REPORT OF THE COMMITTEE ON THE J. LAWRENCE SMITH FUND.

The committee has the honor to submit the following report for the last year:

No application for aid in any new investigation has been received during the year.

As was reported a year ago, certain results of the investigation of meteor trains conducted by the late C. C. Trowbridge, with the aid of grants from the J. Lawrence Smith fund, have been embodied in four papers by Mabel Weil and transmitted to this committee. These papers have been critically examined by Frank Schlesinger, a member of the committee, who reports that they are well worthy of publication but that some revision and editorial work is desirable. This will require conference with Miss Weil and clerical assistance, involving some expense. If this outlay can be provided for, Prof. Schlesinger will undertake the editorial preparation of these papers for publication.

It seems to the committee desirable that the results of Prof. Trowbridge's work should be published in the Proceedings of the National Academy. It also appears appropriate that the cost of editing the manuscripts by Miss Weil and a material part of the cost of publishing them in the Proceedings be met by a grant from the income of the J. Lawrence Smith fund.

It is recommended that the Academy authorize the chairman of the committee on the J. Lawrence Smith fund to approve vouchers for expenditures incurred in the editing and publication in the Proceedings of the Academy of papers by Mabel Weil, presenting results of researches on meteor trains by C. C. Trowbridge, in the total sum of $300, or as much thereof as may be necessary.

The grant of $400, made in 1917 to Dr. George P. Merrill, United States National Museum, in aid of the chemical study of certain meteorites has not been entirely expended. Further investigations under this grant are now being planned.

The observation of meteor paths and radiants and the computation of parabolic orbits, an investigation under the direction of S. A. Mitchell, by C. C. Olivier and others, which has been supported through a term of years by grants aggregating $2,000 from the J. Lawrence Smith fund, has reached the point of publication of results. A discussion by C. C. Olivier of 22,000 observations, made prior to 1919, is now in press, to appear as a publication of the Leander McCormick Observatory of the University of Virginia.

On April 1, 1921, the available income of the Smith fund was $4,201.35, of which $1,641.35 is in cash and the remainder invested. The only liability is an unpaid grant of $500 to S. A. Mitchell.

Respectfully,

WHITMAN CROSS, *Chairman.*

April 25, 1921.

Report received and recommendation approved.

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2138 BANCROFT PLACE,
Washington, D. C., June 30, 1921.

Members of the committee on the J. Lawrence Smith fund.

GENTLEMEN: I inclose a copy of the annual report submitted at the April meeting of the Academy.

The most interesting point is with regard to the appropriation of $300 to aid in preparation and publication of Miss Weil's papers. I explained the situation and stated definitely that the committee were unanimous in the belief that it was a proper and wise use of the Smith fund income to aid in the publication of results of investigation whenever conditions seemed, in the opinion of the committee, to make such expenditure desirable.

There was some discussion, no direct opposition, and, in putting the motion to approve the report, President Walcott pointed out that approval practically made a general precedent, to which he saw no objection. There was no dissenting vote.

Under the approved recommendation, the expenses of Dr. Schlesinger in conferring with Miss Weil and in otherwise preparing her manuscripts can be met and a substantial contribution made toward cost of publication in the Proceedings.

On April 1, 1921, the available income of the Smith fund was $4,201.35, of which $1,641.35 is in cash and the remainder invested. The only liability is an unpaid grant of $500 to S. A. Mitchell.

Sincerely,

WHITMAN CROSS,
Chairman, Committee on the J. Lawrence Smith Fund.

Report received and special appropriations approved.

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REPORT OF THE COMMITTEE ON THE COMSTOCK FUND.

On behalf of the committee in charge of the Comstock fund, I beg to report:

(*a*) That the treasurer announces, as of March 31, 1921, an uninvested income of $1,587.77.

(*b*) That the second award of the Comstock prize having been made in 1918, the next award will be due in 1923, and a recommendation from the committee may be expected at the fall meeting of the academy in 1922.

EDWARD L. NICHOLS, *Chairman.*

Report received.

REPORT OF THE COMMITTEE ON THE ELLIOT FUND.

Your committee on the award of the Elliot medal and honorarium for the year 1919 desires to recommend that the award be made to Robert Ridgway, in recognition of his classic work, Birds of North and Middle America, of which Part VIII is the basis of the proposed award.

We are enabled to present herewith a letter (Jan. 29, 1921) by the dean of American zoologists, Dr. J. A. Allen, with a report on Ridgway's work, which presents more fully than we can why Dr. Ridgway should receive this special recognition by the National Academy of Sciences.

CHARLES D. WALCOTT.
FREDERIC A. LUCAS.
HENRY FAIRFIELD OSBORN.

Report received.

REPORT OF THE COMMITTEE ON THE MARSH FUND.

The members of the Marsh fund committee, John M. Clarke, Charles Schuchert, and J. C. Merriam, met at the Astor Hotel, New York City, on Saturday, April 9, 1921, for a consideration of grants suggested to the committee for the year 1920–21. Preliminary to the discussion of the recommendations for grants, Mr. Merriam, chairman of the committee, presented the following statement of funds available for the current year:

"As chairman of the Marsh fund, National Academy of Sciences, you are advised of the condition of that fund as of March 31, 1921, as follows:

Uninvested income	$1,812.57
Invested income	150.00
Uninvested capital	-------
Invested capital	20,000.00

"To the original capital bequest of $10,000 the academy has added interest received from the estate and has authorized the increase of the fund to $20,000 by annual additions from income, and the fund has now reached the authorized amount by the addition of $500 on February 1, 1920."

Considering the sum available, it was deemed by the committee desirable to use a part of the uninvested income for the present year in grants.

After considering the proposals for grants presented to the committee, the following assignment of funds was approved:

C. W. Gilmore, associate curator of the division of palaeontology, United States National Museum. Grant for the purpose of studying the extinct lizards pertaining to the order of Sauria, with a view to the preparation of a monographic study of this group ---------- $400

Dr. Carl O. Dunbar, of the Peabody Museum, Yale University. Grant for the collection of fossil insects from the permian of America, with the understanding that these collections shall be studied by Dr. Tillyard of New Zealand, and that this work shall be conducted under the direction of Dr. Charles Schuchert ---------- 400

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Anna N. Tolhurst. Grant for stenographic and clerical labor in completing the biography of James Hall $100

Dr. W. J. Sinclair, of Princeton University, Princeton, N. J. Grant for researches on the fauna of the typical Oreodon Zone of Leidy in the White River Oligocene 400

Monseiur Ferdinand Canu, of Versailles, France, and Dr. R. S. Bassler, of the National Museum, Washington, D. C. Grant for the preparation of materials for monographic studies 400

J. C. MERRIAM, *Chairman.*

Report received and recommendations approved.

REPORT OF THE COMMITTEE ON THE MARY CLARK THOMPSON FUND.

The committee on the Mary Clark Thompson fund recommends that the first award of the Mary Clark Thompson gold medal be made to Charles Doolittle Walcott, Secretary of the Smithsonian Institution, Washington, D. C., for his distinguished and unsurpassed contributions to the sciences of geology and paleontology, at the annual meeting in April.

JOHN M. CLARKE, *Chairman.*

FEBRUARY 23, 1921.

With the approval of 10 members of the council, the home secretary presented the recommendation by mail to the academy. Unanimously approved.

BUILDING PLANS.

The plans prepared by Mr. Goodhue for the building of the National Academy of Sciences and the National Research Council reached Washington during the course of the annual meeting and were placed on exhibition during the last day.

RECOMMENDATIONS FROM THE COUNCIL.

The following recommendations from the council were adopted:

That the election of new members and two members of the council be held Wednesday morning, April 27, 1921.

That the American Security & Trust Co., of Washington, D. C., and Spencer Trask & Co., of New York, be designated fiscal advisers of the academy for the year 1921–22.

That the time and place of the autumn meeting, 1921, be left to the president and home secretary with power.

That the annual dues for the first half of 1921 be $2.50, and for the fiscal year July 1, 1921, to June 30, 1922, $10.

It was the understanding of the council, in connection with the fixing of the annual dues, that only $5 of the annual dues of each member would go to the support of the Proceedings and that the remainder would be credited to the general fund.

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AMENDMENT TO RULES.

The following change in Rule V, section 1, was submitted from the council:

Change Rule V, section 1, by striking out all of paragraph 1 except the following:

The publication of the Proceedings shall be under the general charge of the council, which shall have final jurisdiction upon all questions of policy relating thereto. The managing editor, who may be a nonmember of the academy, shall receive a salary, which shall be fixed by the council.

Add the following:

The National Academy of Sciences and the National Research Council shall cooperate in the publication of the Proceedings, beginning with Volume VII.

The management of the Proceedings shall be vested in an executive committee of three, consisting of the managing editor as chairman, for a term of one year, of a representative of the Academy, and a representative of the National Research Council, each to be appointed for a term of three years.

The editorial board shall consist of the home secretary and the foreign secretary of the Academy, the chairman and the permanent secretary of the National Research Council as ex-officio members, and in addition, of ten representatives of the Academy and seven representatives of the Research Council, these numbers corresponding to the number of sections of the Academy and the number of divisions of science and technology of the Research Council.

Beginning with Volume VII, the operation of the Proceedings shall be placed upon a budget basis, the size of the volume in any year to be determined by the conditions of the budget, the equal amounts contributed by each organization being determined by mutual agreement before the beginning of each calendar year.

The managing editor of the Proceedings shall be appointed by the council of the Academy and the executive board of the National Research Council upon the nomination of the editorial board.

HUMANISTIC SCIENCE.

The following statement of Mr. J. C. Merriam, as chairman of the committee, on the possibility of adding to the membership of the academy by further representation of eminent investigators in humanistic science was considered and placed on file:

Dr. CHARLES D. WALCOTT,

President National Academy of Sciences.

DEAR DR. WALCOTT: In response to your request for a statement concerning the possibility of adding to the membership of the National Academy by further representation of eminent investigators in humanistic research, permit me to present the following material for your use at the next meeting of the council of the academy:

At a meeting of the council of the academy on April 27, 1919, the president of the academy invited Dr. James H. Breasted to appear before the council to present a communication from a special committee of the American Oriental Society regarding the feasibility of inviting a group of 50 or 60 men to form a national academy of humanistic research under the charter of the National Academy of Sciences. After discussion of the question at this meeting,

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it was moved to appoint a committee to consider a plan for carrying out a national organization for humanistic research. The president appointed George E. Hale, E. L. Thorndike, and J. C. Merriam, chairman, to consider this question.

At the annual meeting of the academy on April 26, 1920, this committee reported on its investigation of the relation between the past work of the academy and the field for scientific investigation in humanistic study. Attention was called to the desirability of developing in the academy a strong group of men interested in the scientific aspects of humanistic research such as are represented in phases of scientific application included in engineering or medicine. It was proposed that the academy give careful consideration to three possible methods by which investigators working through application of scientific method in the humanistic field might advantageously be added to the membership of the academy. These methods were as follows:

1. By additions to the section of anthropology and psychology.

2. By establishment of a special section of humanistic research to include a small group comparable to the existing sections of the academy.

3. By formation of a division of humanistic research of the order and magnitude of the academy as now composed of representatives in the natural sciences, assuming, however, that for many years to come the actual number of members of the humanistic division would probably not exceed 50 to 100.

An additional or fourth suggestion involves the possible initiative on the part of the National Academy of Sciences of a movement to call together a group of representatives of humanistic research to form a new academy coordinate with the National Academy of Sciences, but representing investigation in the humanistic fields.

The committee expressed its desire to have these several proposals discussed by the academy, and recommended that after such review the question be considered further and more fully before the council of the academy. It was hoped that the council would present before the academy such a plan as could be presented for vote by the academy.

Recommendations.—As chairman of the committee considering the question of humanistic research I have interviewed many members of the academy in the course of the past two years and have found much support for a view accepting the appropriateness of representation in the academy for such thoroughly scientific work as is carried on in the field of humanistic investigation. This type of study may well accompany the present representation of the fundamental natural sciences, together with economic, medical, and engineering application of science. The academy does not seem to me, in general, to favor extending its work away from investigations of the strictly scientific type, and the members do not, I believe, desire to risk expanding the work of the academy into the field of emotional rather than scientific activity. While it is recognized that scientific work may reach into investigation in humanistics as well as in economics, there is a desire to limit our activities to such a range of subjects as can be comprehended and effectively organized.

With due consideration to all of the data assembled, it appears to me that to represent effectively the unquestioned leadership in all phases of scientific work represented in America, we should make certain that eminent investigators whose approach is strictly scientific should be included in the membership of the academy regardless of the particular field of knowledge in which the work happens to lie. It is the function of the academy to develop all of science not only in recognized distinct departments but also in its entirety. Clear distinction should be made between activities which are based upon

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science and reason and those which are directed by emotional or subjective influences, and care should be taken to base the membership of the academy on attainment in purely scientific work.

As to the method which the academy might use in concerning itself with humanistic research, I would remark that if humanistic research is not scientific, it should not be included in the academy, and this body should refrain from taking the initiative to organize another and coordinate body as is suggested under the fourth possibility in the report of the committee in April, 1920.

If investigation in the humanistic field is strictly scientific, I believe that the academy should extend its membership as rapidly as possible to include leaders of thought in this country whose work falls within the scope of this body. The men whose names are added can be attached to existing sections, in some cases, without disorganizing the work of the sections now formed. It does not seem to me desirable to refer humanistic research arbitrarily to the section of anthropology and psychology, although many men will find their place in this section. It may be desirable to form one or more new sections in the course of time, as, for example, in history, if this subject becomes established as a science. For the present I would not recommend establishing a new section .

Inasmuch as the nomination of the members of the academy from sections is at the present time limited to the fields covered by these divisions of the academy, it seems desirable for the council to take the initiative in recommending from year to year the several leaders in the field of humanistic research to be voted upon by the academy as a whole, and to be attached to existing sections until such time as a sufficiently large group appears to warrant the existence and operation of new sections. I do not believe that the number of persons to be added to the present should exceed more than five or six, and that the names which might be considered by the council should include, first of all, persons whose work clearly is scientific, although extended into humanistic fields. Unquestionably, one of the best representatives of this group would be Prof. James H. Breasted.

If I can be of further service to the council I shall be glad to discuss this matter with you or with members of the council.

J. C. MERRIAM.

CONSERVATION OF NATURAL RESOURCES.

The following communication of Mr. Merriam was considered:

The SECRETARY NATIONAL ACADEMY OF SCIENCES.

DEAR SIR: Having been designated as chairman of a committee on conservation appointed by the National Academy of Sciences for the purpose of considering the best methods used in promoting interest in matters on conservation, particularly concerning problems of science and education, I asked the committee of the National Academy to meet jointly with similar committees, of which I am also chairman, appointed by the American Association for the Advancement of Science and the National Research Council. The joint meeting of these committees was held in New York City on Saturday, April 9, 1921, full representation of all of the members being present. At this joint meeting full discussion was had by members of the three committees, and after careful consideration the following resolution was unanimously approved, the chairman being requested to present this resolution for consideration and approval by the organizations represented:

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Resolved, That it be recommended by the committee appointed by the American Association for the Advancement of Science, the National Academy of Sciences, and the National Research Council that they form a continuing joint committee on national conservation representing those organizations and that this committee be authorized to set up an executive and secretarial agency for the active prosecution of the work.

May I therefore ask that the matters concerning this resolution be considered by the council of the National Academy of Sciences in the hope that the council may approve this resolution in the near future?

J. C. MERRIAM.

The following recommendations from the council regarding the joint committee on national conservation were adopted:

That the joint committee on national conservation be authorized to set up an executive and secretarial agency for the active prosecution of its work, provided that the funds can be secured.

That the suggestion be made to the chairman of the committee that he apply to the directors of the Bache fund for an appropriation not to exceed $250 for the initial expenses referred to in the report of the chairman of the joint committee on national conservation.

That the president be authorized to appoint three members of a joint committee on national conservation, and that the present committee be discharged.

PUBLICATIONS FOR SCIENTIFIC MEN IN RUSSIA.

A request for the sending of publications for scientific men of Russia was considered, and the president of the academy stated that the Smithsonian Institution will forward publications through the International Exchange Service through the English committee.

NATIONAL RESEARCH COUNCIL.

AMENDMENT TO ORGANIZATION.

The following amendment to the organization of the National Research Council, recommended by that council, was approved:

SEC. 3. The officers of the National Research Council shall consist of a chairman, a chairman of the executive board, one or more vice chairmen, a permanent secretary, and a treasurer, who shall also serve as members and officers of the executive board of the council.

RESIGNATIONS.

The resignations of Mr. Charles D. Walcott as president and Mr. George E. Hale as foreign secretary were presented.

The following letter from the president to the home secretary was read:

DEAR MR. ABBOT: Section 1 of Article II of the constitution of the National Academy of Sciences is as follows:

"The officers of the academy shall be a president, a vice president, a foreign secretary, a home secretary, and a treasurer, all of whom shall be elected for a term of four years, by a majority of votes present at the first stated meeting

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after the expiration of the current terms, provided that existing officers retain their places until their successors are elected." * * *

At the time of my election as president of the academy, at the annual meeting in 1917, I stated informally that I proposed to terminate my term at the end of four years, although when elected the constitution provided that the term would be six years. I think that this would be in accordance with the spirit of the present constitution, and I therefore present my resignation as the president of the academy to you, in order that you may notify the membership in sending out the notices for the annual meeting in April, 1921.

Sincerely yours,

CHARLES D. WALCOTT, *President.*

The president stated, in laying his resignation before the academy, that when the constitution was changed, making the terms of officers four instead of six years, he had said that he would retire at the end of four years. He felt, having served the academy nearly 23 years as treasurer, member of the council, vice president, and president, that he should be relieved of the activities and responsibilities of the office in order that he could devote his entire time to research work. He advised the election of a younger man, who could devote more time and energy to the many important matters which will come up in connection with the building for the Academy and Research Council, and called attention to the able efforts of Mr. George E. Hale as foreign secretary and in the organization of the National Research Council. After suggesting and nominating Mr. Hale as his successor the president left the room.

Upon motion of Mr. Hale, which was promptly seconded and adopted, the academy voted that Mr. Walcott's resignation be not accepted, and that he be informed that it was the earnest desire of the academy that he remain as president throughout the full term of six years for which he was elected. After much persuasion Mr. Walcott was finally prevailed upon to continue in office throughout the remainder of his term.

The resignation of Mr. George E. Hale, reading as follows, was presented:

DEAR DR. ABBOT: Please present to the academy my resignation from the position of foreign secretary, to take effect at the next annual meeting. The organization of the division of foreign relations of the National Research Council, of which the foreign secretary of the academy is ex officio chairman, makes it important to elect a foreign secretary who can give adequate attention to the work of the division. He should also keep in close touch with the International Research Council, and attend the meetings of its executive committee, from which I shall be glad to resign as soon as this change can be made.

In closing a term of 11 years as foreign secretary, I wish to express my thanks to the academy and my appreciation of the great privilege of conducting the very interesting work of this office. The possibilities of the International Research Council and its associated international unions, and of the various national committees of these unions in the United States; the interest

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shown by the State Department in international scientific relations, and the consequent appropriation by Congress to pay our dues in the International Research Council; and the rapidly growing appreciation by men of science of the possibilities of international cooperation in research, give to the foreign secretary and to the division of foreign relations an opportunity for work of far-reaching importance. I bespeak for my successor the same cordial and unqualified support that the academy and its council have so freely accorded me in the past.

Sincerely yours,

GEORGE E. HALE, *Foreign Secretary.*

The resignation of Mr. Hale was accepted with regret, and with an expression of the academy's high appreciation of his services as foreign secretary. In order that the academy might not lose the benefit of his experience and counsel in its transactions, Mr. Hale was elected to and prevailed upon to accept a seat on the council of the academy.

ELECTIONS.

Foreign secretary.—Mr. R. A. Millikan was elected foreign secretary to complete the unexpired term of Mr. Hale.

Members of the council.—Mr. Raymond Pearl was reelected to membership on the council, term expiring in 1924. Mr. George E. Hale was elected to succeed Mr. W. H. Howell.

Members of the Academy.—The following were elected to membership:

Chapman, Frank Michler, American Museum of Natural History, New York City.

Emmet, William LeRoy, General Electric Co., Schenectady, N. Y.

Harkins, William Draper, the University of Chicago.

Hrdlicka, Ales, United States National Museum.

Kennelly, Arthur Edwin, Harvard University.

MacCallum, William George, Johns Hopkins Medical School.

Miller, Dayton Clarence, Case School of Applied Science.

Miller, George Abram, University of Illinois.

Robinson, Benjamin Lincoln, Harvard University.

Slipher, Vesto Melvin, Lowell Observatory, Flagstaff, Ariz.

Stillwell, Lewis Buckley, 143 Liberty Street, New York City.

Van Slyke, Donald Dexter, Rockefeller Institute, New York City.

Vaughan, Thomas Wayland, United States National Museum.

Washington, Henry Stephens, Geophysical Laboratory, Washington, D. C.

Woodworth, Robert Sessions, Columbia University.

Foreign associates.—The following foreign associates were elected:

Bateson, William, John Innes Horticultural Institution, Merton Park, Surrey, England.

Eijkman, C., University of Utrecht.

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The home secretary was requested to transmit the thanks of the Academy to the Smithsonian Institution, the United States National Museum, and to the Cosmos Club for the courtesies extended to its members during the annual meeting.

SCIENTIFIC SESSIONS.

MEETINGS OF APRIL 25, 26, AND 27, 1921.

MONDAY, APRIL 25.

SCIENTIFIC PAPERS.

Gilbert N. Lewis: Ultimate rational units (illustrated).

William Duane: The quantum law and the Doppler effect.

P. W. Bridgman: Preliminary measurements of the effect of high pressures on the thermal conductivities of liquids (illustrated).

C. E. Mendenhall and Max Mason: The stratification of suspended particles (illustrated).

J. R. Carson and J. J. Gilbert (introduced by J. J. Carty and F. B. Jewett): Transmission characteristics of the submarine cable (illustrated).

J. R. Carson (introduced by J. J. Carty and F. B. Jewett): Radiation from transmission lines.

W. F. Durand: Application of the principle of similitude to the hydraulic problem of the surge chamber (illustrated).

E. H. Hall: Theories of osmotic pressure.

E. H. Hall: Comments on the Borelius space-lattice theory of the metallic state.

G. P. Merrill (introduced by Whitman Cross): Metamorphism in meteorites (illustrated).

W. M. Davis: The Island of Tagula (New Guinea), its satellites and coral reefs.

W. M. Davis: The shallow seas of Australasia.

A. G. Webster: On the radiation of energy from coils in wireless telegraphy.

A. G. Webster: On the vibrations of gun barrels.

A. G. Webster: On the problem of steering an automobile around a corner.

Address by His Serene Highness Albert I, Prince of Monaco, Agassiz medalist, Auditorium United States National Museum.

TUESDAY, APRIL 26.

Edward Kasner: A model of the solar gravitational field.

George D. Birkhoff: On the problem of three or more bodies.

L. E. Dickson: Quarternions and their generalizations.

L. E. Dickson: Investigations in algebra and number theory.

H. F. Blichfeldt: On the approximate solutions in integers of a set of linear equations.

H. N. Russell: A provisional theory of new stars.

F. Schlesinger: The compilation of star catalogues by means of a doublet camera (illustrated).

Vernon Kellogg: The National Research Council (by invitation).

W. S. Adams: The order of the stars (illustrated).

C. G. Abbot: Cooking with solar heat on Mount Wilson (illustrated).

F. W. Clarke: The evolution of matter.

Franz Boas: The differences between variable series (by title).

J. M. Clark: Life of James Hall, of Albany, geologist and paleontologist. 1811–1890 (by title).

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Austin H. Clark: The classification of animals.

L. O. Howard: Attempts to acclimatize *Aphelinus mali* in France, South Africa, New Zealand, and Uruguay (illustrated).

C. D. Walcott: Note on structure of the trilobite (illustrated).

J. C. Merriam: Origin and history of the Ursidae, or bears, in the Western Hemisphere, with particular reference to the bearing of this question on problems of geographical history (illustrated).

H. F. Osborn: The evolution, phylogeny, and classification of the Proboscidea (illustrated).

Simon Flexner: Experiments in epidemiology.

Graham Lusk: Effect of administering various simple metabolites upon the heat production of the dog (illustrated).

Jacques Loeb: The physical and chemical behavior of proteins (illustrated).

Francis G. Benedict, Edward L. Fox, and Marion L. Baker: The skin temperature of Pachyderms (illustrated).

L. R. Jones: The temparture factor in phytopathology (illustrated).

T. B. Osborne and L. B. Mendel: Results of feeding experiments with mixtures of foodstuffs in unusual proportions (illustrated).

C. B. Davenport: Population (illustrated).

E. L. Thorndike: Measuring higher grades of intelligence.

Raymond Pearl and Charmian Howell: A study of specific forces of mortality (by title).

PRESENTATION OF MEDALS.

At the annual dinner of the academy, held at the Powhatan Hotel on the evening of April 26, 1921, the Agassiz gold medal for the year 1918 was presented to His Serene Highness Albert Honoré Charles Goyon de Matignon-Grimaldi, Prince of Monaco, for his original contributions to the science of oceanography. The Agassiz medal for 1920 was presented through Admiral D. W. Taylor to Rear Admiral Charles Dwight Sigsbee, United States Navy, retired. Admiral Taylor received the medal for Admiral Sigsbee, who was unable to be present. The Henry Draper medal, awarded to Pieter Zeeman, professor of physics in the Amsterdam University, for his discovery of the so-called Zeeman effect and for its application in magneto-optics, was presented to Dr. J. B. Hubrecht, secretary of the legation of the Netherlands, for transmittal to Dr. Zeeman. The Daniel Giraud Elliot medal and honorarium, awarded to Robert Ridgway in recognition of his classic work, "Birds of North and Middle America," was presented to the home secretary for transmittal to Mr. Ridgway. The public-welfare medal was presented to Dr. Charles Wardell Stiles, of the United States Public Health Service. The award was made for his application of science to the public welfare in the recognition and eradication of the hookworm disease. Dr. William H. Welch presented the Mary Clark Thompson medal to Dr. Charles Doolittle Walcott, Secretary of the Smithsonian Institution and president of the Academy. The award was made for his distinguished contributions to the sciences of geology and paleontology, and was kept secret from President Walcott up to the time of its presentation, the approval of the Academy having been secured by mail.

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REPORT OF NATIONAL RESEARCH COUNCIL FOR THE PERIOD JANUARY 1–JUNE 30, 1921.

[Prepared by Vernon Kellogg, permanent secretary, and by the chairmen of divisions.]

INTRODUCTION.

The change in the fiscal year of the National Academy of Sciences and National Research Council from the calendar year to one beginning on July 1 of each year and closing on June 30 of the succeeding year brings it about that the last (fifth) annual report of the National Research Council, covering the year 1920, presented an account of the organization of the council which is, in effect, identical with that for the first half of the calendar year 1921, for which period the present report is made. Hence it will be unnecessary to repeat the organization account here.

The activities, also, of the council and its component divisions and committees of the present half year are mostly only the continuation of those already described (in the fifth annual report) for the latter half of 1920. However, certain additions to these activities have been made and these new matters are presented in the reports of the divisions herewith. Certain new publications have been issued in the bulletin and reprint and circular series of the council, which are listed in the report of the committee on publications.

CHAIRMAN AND VICE CHAIRMEN.

The council made no election of a chairman to succeed Dr. Bumstead, whose death on December 31, 1920, was noted in the fifth annual report. Dr. Charles D. Walcott, secretary of the Smithsonian Institution, and president of the National Academy of Sciences, and first vice chairman of the council, assumed the authority of chairman. The executive board, at its meeting on April 24, decided to elect no chairman for the coming fiscal year, but created the position of chairman of the executive board, to which office Dr. John C. Merriam, president of the Carnegie Institution of Washington, was elected. Dr. Charles D. Walcott, first vice chairman; Gano Dunn, second vice chairman; and Dr. Robert A. Millikan, third vice chairman, were reelected.

PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

The council has selected the following members to represent it on the editorial board of the Proceedings of the National Academy of

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Sciences, in conformity with arrangements made with the academy whereby the council shares with the academy the editorial and financial responsibility of the Proceedings: Member of the executive committee, Vernon Kellogg; members of the editorial board, the chairman and permanent secretary of the council, and Messrs. Adams, Cottrell, McClung, Mathews, McCoy, Millikan, Ransome, Trowbridge, Wissler, and Yerkes.

AMERICAN GEOPHYSICAL UNION.

The relation of the American Geophysical Union to the council was changed so that the union as a whole is replaced as a committee of the executive board by the executive committee of the union.

SIGMA XI.

The president of the Sigma Xi Society has been made an ex officio member of the executive board, such election to be made automatically in the case of each successive president.

COMMITTEE ON NATURAL RESOURCES.

By joint action of the National Academy of Sciences, American Association for the Advancement of Science, and National Research Council, a joint committee on natural resources, representing all three of these scientific organizations, has been instituted.

PUBLICATIONS.

Up to April 12, 1921, 11,385 copies of the various issues in the bulletin series of the council and 14,498 copies of issues of the reprint and circular series had been distributed. The following issues in each series have been issued or have gone to press since January 1, 1921:

BULLETIN OF THE NATIONAL RESEARCH COUNCIL.

VOLUME 1.

No. 6. Data relating to X-ray spectra. By William Duane. November, 1920. 26 pages.

No. 7. Intensity of emission of X rays and their reflection from crystals. By Bergen Davis. Problems of X-ray emission. By David L. Webster. December, 1920. 47 pages.

No. 8. Intellectual and educational status of the medical profession as represented in the United States Army. By Margaret V. Cobb and Robert M. Yerkes. February, 1921. 76 pages.

VOLUME 2.

No. 9. Funds available in 1920 in the United States of America for the encouragement of scientific research. Compiled by Callie Hull. March, 1921. 81 pages.

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No. 10. Report on photo-electricity, including ionizing and radiating potentials and related effects. By Arthur Llewelyn Hughes. April, 1921. 87 pages.

No. 11. The scale of the universe. Part I, by Harlow Shapley. Part II, by Heber D. Curtis. May, 1921. 47 pages.

No. 12. Cooperative experiments upon the protein requirements for the growth of cattle. First report of the subcommittee on protein metabolism in animal feeding. By Henry Prentiss Armsby, chairman. June, 1921. 70 pages.

No. 13. The research activities of departments of the State government of California in relation to the movement for reorganization. By James R. Douglas. (In press.)

No. 14. A general survey of the present status of the atomic structure problem. Report of the committee on atomic structure of the National Research Council. By David L. Webster and Leigh Page. (In press.)

No. 15. A list of seismologic stations of the world. Compiled by Harry O. Wood. (In press.)

REPRINT AND CIRCULAR SERIES OF THE NATIONAL RESEARCH COUNCIL.

No. 11. A survey of research problems in geophysics. Prepared by chairmen of sections of the American Geophysical Union. October, 1920. 57 pages.

No. 12. Doctorates conferred in the sciences in 1920 by American universities. Compiled by Callie Hull. November, 1920. 9 pages.

No. 13. Research problems in colloid chemistry. By Wilder D. Bancroft. (In press.)

No. 15. Researches on modern brisant nitro explosives. By C. F. van Duin and B. C. Roeters van Lennep. Translated by Charles E. Munroe. (In press.)

No. 16. The reserves of the Chemical Warfare Service. By Charles H. Herty. February, 1921. 17 pages.

No. 17. Geology and geography in the United States. By Edward B. Mathews and Homer P. Little. April, 1921. 22 pages.

No. 18. Industrial benefits of research. By A. J. Wadhams and Charles L. Reese. February, 1921. (In press.)

No. 19. The university and research. By Vernon Kellogg. (In press.)

CHEMICAL EXHIBIT AND LECTURE.

A popular chemical exhibit, "to show the American people what the chemist has done and may do for them," prepared by the Chemical Warfare Service of the United States Army, and revealing especially the achievements in the chemical industries concerned with the production of dyes, pharmaceuticals, war gases, and explosives, was held in the building of the council in Washington from February 24 to May 14. After this it was transferred to the House of Representatives Office Building, where it remained from May 16 to May 28. Arrangements have been made to install it as a permanent exhibit in the United States National Museum. Duplicates of the exhibit were shown in Philadelphia and New York.

In connection with the opening of the exhibit, a lecture on "The reserves of the Chemical Warfare Service" was delivered under the auspices of the council in the auditorium of the United States National Museum by Dr. Charles H. Herty, editor of the Journal of

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Industrial and Engineering Chemistry and chairman of the committee of the National Research Council to cooperate with the Chemical Warfare Service.

INTERNATIONAL DUES.

By act of Congress, the dues heretofore assumed by the National Research Council in connection with American representation in the International Research Council and Associated International Unions will be paid for the year 1921 by an appropriation included in the diplomatic and consular appropriation bill.

NEW BUILDING.

The plans prepared by Mr. Bertram Goodhue, of New York, for the new building for the National Academy of Sciences and National Research Council have been approved by the Fine Arts Commission and accepted by the Carnegie Corporation, National Academy of Sciences, and National Research Council. The Carnegie Corporation has therefore declared its readiness to meet the expenses as incurred in the erection of the building. It is planned to begin work on the building in the fall of 1921.

REPORTS OF DIVISIONS.

DIVISIONS OF GENERAL RELATIONS.

DIVISION OF FEDERAL RELATIONS.

[CHARLES D. WALCOTT, *Chairman.*]

(For present personnel, see Appendix A.)

The division of Federal relations held its annual meeting on April 6, 1921, when a very comprehensive report was presented by the committee on scope of Government service and discussed at length. A new committee on this important work was formed and authorized to go forward with the bringing together of information as quickly as possible. The committee has been formulating plans and is making progress, but at the close of the year is not ready to recommend any action as to policy regarding the research work of the Government for the future.

Since January 1, 1921, the following new appointments to fill vacancies were announced: Mr. H. Foster Bain to succeed Mr. F. G. Cottrell as representative of the Bureau of Mines of the Department of the Interior; Maj. Gen. Amos A. Fries to succeed Maj. Gen. W. L. Sibert as representative of the Chemical Warfare Service of the War Department; Mr. William A. Kinnan to succeed Mr. M. H. Coulston as representative of the Patent Office of the Department of the Interior.

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The division as it stands has as members representatives from the same departments of the Government listed in its last annual report, there being no changes or additions to the representation of any department.

DIVISION OF FOREIGN RELATIONS.

[ROBERT A. MILLIKAN, *Chairman.*]

(For present personnel, see Appendix A.)

The committee of the division of foreign relations on Pacific investigations, which was organized to continue plans which have been developing for over 10 years for promoting systematic scientific investigations in the Pacific region as a natural and logical unit for study, has been reorganized and now consists of the following members: Herbert E. Gregory, chairman, Bishop Museum, Honolulu; T. Wayland Vaughan, vice chairman, United States Geological Survey; William Bowie, United States Coast and Geodetic Survey; Barton W. Evermann, California Academy of Sciences; John C. Merriam, Carnegie Institution of Washington; William E. Ritter, Scripps Institution for Biological Research; Clark Wissler, American Museum of Natural History.

Believing that, preliminary to definition of the scientific problems of the Pacific and the formulation of plans for working on them, a system of relationships should be set up between the leading scientific bodies of the countries within or contiguous to the Pacific Basin, a communication inviting cooperation has been addressed to about 35 scientific societies and other agencies in those countries. A number of replies have already been received favoring the proposed association of scientific interests. The next step will doubtless be the calling of a conference for perfecting such organization as may be necessary and for continuing the consideration of scientific problems of the Pacific such as were presented at the scientific conference held at Honolulu in August, 1920, and at the Pacific coast conference held at the University of California in March, 1918. It is believed that plans for these investigations and for the conferences to be called upon them can go forward successfully only if under the direction of the scientific organizations which by nature are chiefly concerned with such investigations. This committee has now under consideration several projects of investigation upon problems of the Pacific area.

In April Dr. Augustus Trowbridge, secretary of the division of Federal relations and chairman of the division of physical sciences, went abroad to attend the meeting of the executive committee of the International Research Council in Paris as representative of the

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National Research Council. Although the meeting was necessarily deferred beyond the date originally appointed, Dr. Trowbridge was able, through individual conferences, to accomplish the business of his trip before being obliged to return to this country, especially in effecting cooperation with M. Marie, the publisher of the annual tables of physical and chemical constants, permitting the use of advance information in the preparation of the critical tables of physical and chemical constants for the publication of which the United States is responsible.

Through the efforts of the Department of State an item of $2,658 was included in the diplomatic and consular bill as recently passed by Congress for the payment of the dues of the United States in the following international bodies: International Research Council, International Astronomical Union, International Union of Pure and Applied Chemistry, International Union of Geodesy and Geophysics, and the International Mathematical Union.

The annual meeting of this division was held in Washington on April 19. At this meeting reports were rendered from the various international unions in which the research council is represented. The following table presents the membership in certain of these unions at present:

International Research Council.	International Union of Astronomy.	International Union of Geodesy and Geophysics.	International Union of Pure and Applied Chemistry.	International Union of Mathematics.
Australia				
Belgium	Belgium	Belgium	Belgium	Belgium.
Canada	Canada	Canada	Canada	
			Czechoslovakia	Czechoslovakia.
Denmark			Denmark	
France	France	France	France	France.
Greece	Greece	Greece	Greece	
Holland			Holland	
Italy	Italy	Italy	Italy	Italy.
Japan	Japan	Japan	Japan	Japan.
Mexico	Mexico	Mexico		
Monaco		Monaco		
Norway				
			Poland	
Portugal		Portugal		
Serbia				
Spain	Spain	Spain	Spain	
Sweden				Sweden.
Switzerland				
United States	United States	United States	United States	United States.
United Kingdom	United Kingdom	United Kingdom	United Kingdom	United Kingdom.

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DIVISION OF STATES RELATIONS.

[JOHN C. MERRIAM, *Chairman.*]

(For present personnel, see Appendix A.)

The work of the division of states relations has been continued upon the two problems which were undertaken last year: (1) A study of the status of scientific research in State government, and (2) a study of the nature of the scientific work undertaken cooperatively between bureaus of the Federal Government and corresponding departments in State governments or other non-Federal agencies.

In connection with the first problem it is planned to publish certain of the material collected concerning the situation of research in State government. The first report of this nature to be published will be that of Dr. J. R. Douglas, formerly assistant professor of political science in the University of California, upon "The research activities of departments of the State government of California in relation to the movement for reorganization." This is now in press in the bulletin series of the council. A report upon the activities of the committee on scientific research of the State council of defense of California during the war years is now being prepared for publication similarly. For the further orientation of the division upon this problem the annual meeting of the division in Washington, on May 27, was made the occasion for a symposium upon the conditions affecting scientific research under State government auspices.

The second project has been taken up with all of the scientific bureaus of the Federal Government, and reports are now being prepared by these bureaus, making use of standardized report sheets, upon the nature of the projects undertaken by these bureaus cooperatively with non-Federal agencies, and upon the basis of agreement under which this cooperative scientific work is carried on. This project is under the direction of a joint committee representing this division and the division of Federal relations.

DIVISION OF EDUCATIONAL RELATIONS.

[VERNON KELLOGG, *Chairman.*]

(For present personnel, see Appendix A.)

Special attention of the division of educational relations for the first half of the year 1921 has been given to a study of the detection and encouragement of students of superior ability. In the study of means for detecting such students by mental tests, in connection with attainment records, this division has cooperated with the division of anthropology and psychology.

In order to ascertain what has already been done in this matter, this division has maintained Prof. G. W. Stewart, of the department

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of physics, University of Iowa, in the field during the greater part of the past semester. Prof. Stewart has visited 66 colleges and universities in the States of Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, North and South Dakota, and Kansas for the purpose of discussing this matter at first hand with members of the faculties of these institutions. In a number of cases opportunities were afforded to meet selected groups of students and to address the student body.

Prof. Stewart has found an earnest interest in this matter in all of the institutions which he has visited, and reports that several means, such as the organization of honor societies, the establishment of honor courses, a repeated careful study of students' records, announcements from platforms and in the local press concerning students of special attainment, are being followed for the encouragement of students of superior capacity.

It is believed that Prof. Stewart's conferences at this large number of institutions have served a useful purpose in directing the attention of those institutions toward the importance of this problem and the peculiar significance of the training of superior students. More concerted efforts in this direction are certain to result in many of those institutions. As a practical means of effecting systematic action upon this matter, continuing from year to year, Prof. Stewart has repeatedly suggested the organization of a standing committee upon scholarship with special reference to superior students. A number of such committees have been organized in the institutions which he has visited. It is planned to publish a report upon Prof. Stewart's studies, and also a series of statements concerning the opportunities for research in the various fields of science. Material for this series is already on hand. The results obtained from Prof. Stewart's work this spring are believed to justify the continuation of the study next fall.

The study of the general conditions of research in colleges and universities which this division has been conducting for over a year and a half has also been continued through the visits of representatives of the council. In all, 140 colleges and universities have now been visited in this way. Plans are now under consideration for extending this study of research conditions to a study of the special situation to be found in the various fields of science.

The division has continued the encouragement of the formation of research committees in colleges and universities. In correspondence with these committees and with officers of administration in a large number of institutions 10 or 12 circular letters have been sent out during the academic year containing statements concerning various aspects of research in institutions of higher education. Returns from this correspondence indicate a distinct stimulation of the

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support of research by the appropriation of research funds, the survey of local situations, the study of the vital relation of research to teaching, and increased attention upon research as a legitimate function of these institutions.

The annual meeting of the division was held in Washington on April 18.

DIVISION OF RESEARCH EXTENSION.

[H. E. Howe, *Chairman.*]

(For present personnel, see Appendix A.)

Much of the work of the division of research extension requires a long time for its completion. The work of this division during the last half year has, therefore, been largely concerned with furthering matters initiated previously. Certain of these projects have originated with the division itself, while several others have had the attention of the division officers who serve as members of the promotion committee.

Critical tables of physical and chemical constants.—In this case, as in several other projects, industrial conditions have been a real handicap and have made rapid progress impossible. Of the $200,000 which is to form an underwriting fund, slightly more than 50 per cent has been secured in cash, pledges, and arrangements for service and materials which are the equivalent of money. A start has been made in the actual compilation of the material, the first work consisting in bringing together and classifying published tables which are to be considered as possible material for the critical tables. The organization work has proceeded steadily and the trustees have representatives in several industrial localities. These men are now engaged in giving information regarding the project and will later be active in an effort to secure the remaining funds.

In addition to the trustees representing the American Chemical Society, the American Physical Society, and the National Research Council, Mr. George P. Adamson has been selected to represent the Manufacturing Chemists' Association and Dr. Charles L. Reese to represent the American Dyes Institute on the board of trustees.

The advisory committee, which is to decide questions of editorial policy, has also been appointed by the council upon the nominations of the divisions of chemistry and chemical technology and of physical sciences. The committee has the following personnel:

John Johnston, Sterling professor of chemistry, Yale University, New Haven, Conn.

C. E. K. Mees, director of development and research, Eastman Kodak Co., Rochester, N. Y.

R. B. Moore, chief chemist and Chief Division of Mineral Technology, United States Bureau of Mines, Washington, D. C.

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C. E. Mendenhall, department of physics, University of Wisconsin, Madison, Wis.

Saul Dushman, research laboratory, General Electric Co., Schenectady, N. Y.

G. K. Burgess, Chief Metallurgical Division, United States Bureau of Standards, Washington, D. C.

At present efforts are being made to find an editor who will be able to give full time to the work.

Crop Protection Institute:—The division of research extension had expected that before this the organization of the Crop Protection Institute would be completed and the council represented upon the board of governors by a member from some other division. However, the interest of new industrial groups in the affairs of the institute has been secured and the type of organization has been changed somewhat to make cooperation with these new interests feasible. Slight changes have been made in the constitution to guarantee the control of the institute being in the hands of the scientific members who now constitute a board of control with each industrial group having its own financial trustees. The institute now has some 300 members, of which 23 are classified as industrial and 21 associate-industrial members. The others are scientists.

The Association of Official Agricultural Chemists have now appointed their representatives upon the board of governors.

During this summer a cooperative experiment in dusting is being carried on in Virginia, West Virginia, New York, and Pennsylvania under the direction of Dr. N. J. Giddings as project leader.

Alloys.—The effort to form the Alloys Research Association, which is regarded by the division as an experiment in assembling and disseminating specialized knowledge through cooperative effort, continues to have the serious attention of the division. A prospectus of the project has been prepared and circulated widely. The replies indicate a real interest on the part of industry in the work. A number of subscriptions to the association have been received, but due to the present industrial situation it has not yet been possible to secure a sufficient number of subscriptions to initiate the service. With the return of normal conditions the representatives of the division will take the field in an effort to complete this project and begin the work as outlined.

Tanning.—The division has continued its investigation relative to the establishment of a school for tanning to be affiliated with an established university. The matter has been discussed with a large number of those interested and a definite plan for the undertaking developed. The officers of the division are now determining those schools interested in such work and qualified to carry out the plan. These will be considered with reference to their proximity to the

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tanning centers and a report, with recommendations, prepared for the tanners' council for presentation at their next meeting.

Tobacco.—The project to support research looking to the development of better disease-resisting types of tobacco has not made the progress that had been expected. A few of the tobacco concerns have evidenced decided interest and some subscriptions have been obtained. The financial situation has not been encouraging to the growers, and it now appears that it will take more time before this work can be completed.

Glass.—The committee appointed by the American Ceramics Society to cooperate with this division obtained suggestions from a number of technical men in the industry relative to those projects upon which research in glass could be undertaken to advantage and, with their assistance, is now engaged in formulating a definite scientific program which will then be taken to the manufacturers themselves.

Textile research.—There have been a few important developments, especially with relation to research in cotton, and plans are now being formulated looking to the establishment of an American Textile Research Institute. Mr. D. E. Douty, who has served as the chairman of the preliminary committee on American cotton research, has found it necessary to resign, due to a long absence from the country, and the chairman of the division has been elected to succeed him.

The cooperation of the American Home Economics Association continues, and it is hoped that within a short time actual work can be begun upon their program looking to the establishment of minimum standards of wear for the principal fabrics in the wardrobe.

Electrodeposition.—After a conference with officials of the Bureau of Standards and with the approval of the division, work has been undertaken looking to increasing support given to the Bureau of Standards for research on the fundamentals of electroplating. The work of the division is being carried on with the assistance of the American Electroplaters' Society and interested individuals in industrial localties. It is hoped to secure the interest of a large number of manufacturers through an annual subscription of $100 each rather than appeal for larger funds from a smaller number.

Margarin.—In cooperation with the division of biology and agriculture assistance is being rendered the Independent Margarin Manufacturers' Association in formulating a plan for research which it is hoped the association will adopt and support.

Ceramics.—Important cooperative work is now in progress involving the Bureau of Mines, the Bureau of Standards, and associations composed of the manufacturers of heavy clay products. It is pro-

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posed in time to extend this work to higher grade clay products, especially white ware.

Exhibits.—Following the policy of attracting attention to fundamental research through popular exhibits the division arranged for the cooperation of the Chemical Warfare Service, and a popular chemical exhibit was installed in the rooms of the council for several weeks. This exhibit was then shown in the Office Building of the House of Representatives and is now deposited in the United States National Museum. A duplicate of the exhibit has been shown in Philadelphia, Wilmington, and Springfield, and is later to appear in connection with the National Exposition of Chemical Industries in New York. A booklet was issued in connection with this exhibit, and a number of thousands of copies have been mailed throughout the country. Science Service has been of great assistance in securing favorable notice of this exhibit in the press.

Horological conference.—In May a horological conference was held at which the means to be taken to increase the attractiveness of watchmaking and repairing for younger men was discussed, as well as the stabilization of the watchmaking profession with special reference to the certification of watchmakers. In the conference, representatives of horological schools, of manufacturers, of merchants, the trade press, and various Government departments participated, and first steps were taken toward the formation of a Horological Institute of America, which will be concerned primarily with the scientific phases of time keeping with special reference to the mechanical devices necessary.

Georgia School of Technology.—The chairman of the division represented the council during the first week of April on a tour in the State of Georgia, undertaken to interest the people as a whole in the support of technical education and in the direct support of the Georgia School of Technology. This was viewed by the division as something of an experiment to see what could be done by this method in arousing the interest of a large number of laymen in technical education and in research pertaining thereto.

Miscellaneous.—Contact has been maintained with projects which have previously received the attention of the division, and preliminary work has been begun on the marine borer project and on the organization of research on corrosion. The division has continued to render such assistance as it could to individuals and organizations.

RESEARCH INFORMATION SERVICE.

[ROBERT M. YERKES, *Chairman.*]

(For present personnel see Appendix A.)

During the six months ending June 30, 1921, the activities of the research information service have been carried on by a resident

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staff of 5 technical and 4 clerical members, working under the guidance of an executive committee of 7 and a consultant divisional committee of 38. The technical staff, when necessary, has called upon other resident members of the council for advice or assistance in matters pertaining to their respective fields.

The purpose of the service is to promote scientific and industrial research in this country through the operation of an active exchange for all kinds of scientific and technological knowledge. Questions have been answered concerning research problems, projects, work in progress, and results; methods and processes; laboratories, equipment, and apparatus; publication, funds, and personnel.

Approximately 675 requests for information on a wide range of scientific and technological subjects have been received by the research information service. In answering these requests, either the information desired was furnished by the service to the correspondent or sources from which it could be obtained were indicated. A complete record of each request, including the date, the information requested, sources consulted, and data furnished, has been entered on a card which is filed by subject. That inquirers have been obtaining helpful information is shown by return cards sent out to determine the value of replies made by the service. Of those returned, 97 per cent have reported that the information was useful.

In order to acquaint scientific workers with the availability of this "miscellaneous request service," a small eight-page folder, describing its function, scope, and basis of service, was issued early in 1921. This was printed in an edition of 19,000. About 4,000 copies were distributed among the fellows of the American Association for the Advancement of Science. The announcement was also sent to officials in American colleges and universities, directors of research in industrial laboratories, and to those listed as correspondents of the research information service. The remainder was put at the disposal of members of the council. The distribution of this folder resulted immediately in a marked increase in the number of inquiries received by the service.

To assist the staff of the research information service in answering requests, a file of informational sources is being developed. This file has been planned to include informational bureaus, individual specialists, special libraries, special laboratories, institutions, and firms which are recognized authorities on certain subjects. The value of this file in listing possible sources of information and in indicating those which are most satisfactory has been amply demonstrated.

Progress has been made in the collection of basic source books which are used for scientific reference. This collection includes dic-

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tionaries, bibliographies, year books, directories, abstract journals, and reference books in special subjects. In connection with the source file, this library is particularly useful as a guide during the preliminary work on requests.

The service has continued its activities along the line of collecting and publishing important scientific information. The task of preparing for publication Bulletin No. 9, Funds Available in 1920 in the United States of America for the Encouragement of Scientific Research, has been completed. The list gives an account of medals, prizes, grants, and research scholarships and fellowships amounting in value to approximately $36,000,000 annually. New records concerning industrial research laboratories have been entered, and with the cooperation of the Chemical Catalogue Co. a final survey of the chemical industries is under way, preparatory to the publication of a second edition of "Research Laboratories in Industrial Establishments of the United States of America."

In cooperation with special libraries the service has also assisted Mr. W. I. Swanton, of the Reclamation Service, in preparing for publication a reference list of 170 Washington libraries. This list gives the location of the library, the name of the librarian, a general account of the subjects covered by each collection of books and the approximate number of volumes.

A card file of bibliographies has been initiated which will include all of the sciences, with their applications, and will cover all published material to date. In addition to published material, an attempt is being made in cooperation with the divisions of the National Research Council to compile a list of unpublished bibliographies in the United States. The information will include, besides the author, title, publisher, date and place of publication, the form of publication, the location of the bibliogprahy, and a brief annotation as to its scope. In the compilation of this bibliography of bibliographies the cooperation of specialists in each science will be enlisted. Work is under way on the lists for chemistry and geology. Whenever possible, copies of bibliographies are obtained and held on file in the Research Information Service. Photostats of rare publications are made for the benefit of those desiring copies.

A revision of the union list of periodicals in the District of Columbia, published in 1901 by the Library of Congress, has long been needed, and this work has lately been undertaken by the service with the cooperation of Mr. Meyer, chief bibliographer of the Library of Congress and the District libraries. The material is being brought to date and will include all serials regularly received in the District of Columbia as of July 1, 1921. Instead of canvassing the large libraries only, about 170 libraries have been asked to send in lists of their serials. The name of each library will appear in connection

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with periodicals taken by it, if they are not available in at least four of the large libraries.

The service has started a survey of museums, academies, individuals, and commercial concerns in possession of lantern slides which may be borrowed, rented, or bought. The collection of information will not be limited to American agencies. A number of catalogues have already been received, and an index by subject has been started.

The file of research laboratories, furnishing essential information concerning scientific laboratories in which investigations are conducted, has been further enlarged. Many of these records were obtained by direct report from the laboratories. Revision and supplementation has continued slowly on the basis of information obtained from correspondence, available publications, and other sources. This file is maintained for the purpose of indicating the research interests, activities, and facilities of research laboratories.

Work on research personnel has centered chiefly about an experiment for mechanizing the information. The Findex system has been applied to one group of approximately 400 scientists. The research personnel file promises to become an important source of information for a number of scientific inquiries in addition to its more specific use in selecting lists of persons meeting particular requirements. In addition to research in personnel records, the service has a catalogue of 20,000 chemists and mining engineers which was compiled by the Bureau of Mines as an important war project.

The file of current investigations has been continued as an important supplement to other informational mechanisms. Facts about investigations in progress are continually noted but because of difficulties in actively seeking this kind of data and keeping them current, the file can never become complete. It is being gradually perfected, however, as other activities of the service develop. It has been found particularly useful for carrying details which can not be described in other informational files. The laboratory records, for example, reveal the general trend of research and the facilities in a particular center. Also the personnel record enumerates individual research projects which are under way. As additional details of particular current investigations become known, the facts are recorded as supplementary information in the current research file.

DIVISIONS OF SCIENCE AND TECHNOLOGY.

DIVISION OF PHYSICAL SCIENCES.

[AUGUSTUS TROWBRIDGE, *Chairman.*]

(For present personnel see Appendix A.)

The principal work of the division for the period January 1 to June 30, 1921, has been the maintenance and extension of the research

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committees originally established during the chairmanship of Dr. Mendenhall. At present there are 18 such committees, with a total membership of 107. Of these committees three are in the field of astronomy, one in mathematics, and the remainder in the field of physics. Seven completed reports by these committees have so far been published or are now in press.

At the close of 1920 approximately $7,000 of the original grant of $20,000 from the Rockefeller Foundation for the maintenance of these committees reverted, but a new grant of $15,000 was made by the foundation for the maintenance of these committees during the year 1921. The committees which have been started at work under this new appropriation are in borderland fields between the subjects covered by the division of physical sciences and other divisions of the council.

The experiment of cooperative work being carried out through these research committees is, in the opinion of the chairman of the division, to be regarded as highly successful. The average cost per member per meeting of these committees is in the neighborhood of $30. The cost of publication of the reports will vary widely according to the size of the report. At least two of the committees intend to publish reports, the publication of which may not have to be borne by the funds of the council, since there is a demand for these reports sufficient to warrant a publishing house in financing the publications. These two reports will be, respectively, a Manual of Research Technique and a Manual on the Use of Statistics.

Other Activities.

In connection with the negotiations for the establishment of a scientific instrument journal, the division has withdrawn from the original attempt to have the journal conducted under the sole auspices of the National Research Council and has started direct negotiations between the instrument makers on the one hand and the Journal of the Optical Society of America on the other, looking toward the publication of the instrument journal under the auspices of this society. At present no financial support from the council to the joint enterprise is contemplated.

Two special projects of the division have received financial support to the amount of $500 each from the general funds of the council. These are the project of a revolving fund for securing the publication of mathematical monographs, and a contribution to the endowment fund which is being raised by the mathematical societies for the publication of mathematical abstracts. A third special project, namely, that of emergency support for the Journal of the American Mathematical Society, has received support from the council to the extent of $600.

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During the past six months the chairman of the division of physical sciences, working in conjunction with the division of engineering, has organized an American section of the International Union of Scientific Radio-Telegraphy. France already has such a union, and it is expected that England, Italy, and Belgium will complete their organizations during the coming summer.

With the consent and, indeed, at the original suggestion of the Director of the United States Bureau of Standards, the division is endeavoring to devise some feasible method whereby the facilities of the bureau can be made available for wider utilization by research men. As a beginning in this undertaking the chairman of the division has been authorized to circularize the principal laboratories of physics of the country, stating the willingness of the Director of the Bureau of Standards to cooperate in special pieces of work, and inviting requests for such assistance to be sent to the chairman of the division.

Research Fellowship Board.

A considerable portion of the time of the chairman of the division has been devoted to the duties of the secretaryship of the research fellowship board. At the time of present writing (June 16) the number of fellows either holding fellowships or appointed to fellowships on which they will enter in the course of the next few months is 29, 10 of these in physics and the remaining 19 in chemistry. The number of applications for fellowships is steadily increasing, and the board feels that in the future it is desirable to arrange for personal interviews between the candidates and the secretaries of the board before the candidates' cases are brought before the board for final action.

DIVISION OF ENGINEERING.

[C. A. Adams, *Chairman.*]

(For present personnel, see Appendix A.)

Apart from the activities connected with specific projects, a brief account of which is given below, much of the time of the chairman during the past six months has been devoted to the establishment of the new plan of organization which involves the active participation of the engineering societies on the division.

This plan of organization which has been described more in detail in previous reports, has as its salient feature a general advisory board in each branch of engineering, which is sponsored by the appropriate society, and under which the several projects in that field are organized.

As in some cases this involves the reorganization of the research work of the societies and a closer coordination of that work with

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the Division of Engineering, progress is necessarily slow; however, this work is progressing steadily and its completion will place the division in a much stronger position, with real working connections with the engineering societies which are represented on the division.

RECENT PROGRESS OF ACTIVE PROJECTS.

Heat treatment of carbon steel.—Funds for the conduct of this work up to the first of the year were provided by the United States Bureau of Mines and United States Bureau of Standards. Owing to the curtailment of the congressional appropriations for these bureaus, they are no longer able to render sufficient financial assistance. The National Research Council has therefore recently appropriated $1,000 which will be largely used for machining specimens. The services of Prof. Charles Y. Clayton, of the Missouri School of Mines, have been secured to assist Dr. Henry M. Howe in completing these investigations, his services to be paid for by the Bureau of Mines. A progress report will be published shortly which will contain the results obtained from the investigations up to date.

Fatigue phenomena of metals.—The original program provided for under the $30,000 appropriation of the Engineering Foundation has been completed, and considerable progress has been made on the extension of the investigations to study the fatigue properties of nickel-steel, which was financed by the General Electric Co.

The results of the investigations indicate that a rise of temperature test may furnish a reliable accelerated test for fatigue resistance. Although this test may not apply to alloy steels it seems to predict endurance limits for carbon-steel with accuracy, and a test can be completed in half an hour. Among the factors which lower the resistance of metals to repeated stresses may be mentioned:

(1) Sudden changes of the outline of the part.

(2) Localized stresses due to poor surface finish or to cracks in grooves caused by wear, by accidental blows, or by improper heat treatment.

(3) Occasional overload, either a heavy overload applied a few times or a light overload applied some thousands of times.

A report embodying the results of the investigations is now finished and will be published shortly. This report contains the most valuable and complete information ever published on this subject.

Other industries are taking an interest in this work as is also the Air Service of the War Department, and this is likely to permit further extension of the program.

New hardness testing machine.—This committee has summarized its work in a paper which will be published in the July issue of the American Society of Mechanical Engineers. The report contains a

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great amount of test data obtained by the committee and also a very complete summary of available knowledge on this subject.

Steel ingots.—This committee was originally organized during the war to determine the best open-hearth practice for the manufacture of gun steels and fine steels generally, and to disseminate the information among the various manufacturers to the end of eliminating as far as possible numerous rejections, particularly on ordnance orders. The work has been completed and summarized in a report prepared by Dr. Henry M. Howe and Col. W. P. Barba, which will be published shortly. This report constitutes what is probably the best set of specifications for acid open-hearth practice ever prepared. Although the present activities of the committee have been completed there is a strong feeling that inasmuch as its membership constitutes the foremost experts on steel in the country, the committee should not be discharged.

Neumann bands.—The tests originally planned have been completed and a report will be published shortly. However, the work of this committee will be continued with a view to ascertaining whether the presence of Neumann bands is evidence of weakness of the metal, and the kinds of steel favorable for the production of Neumann bands.

Substitute deoxidizers.—The first phase of the work involving laboratory tests of fusibility and viscosity is finished, and the second dealing with the manufacture of the most promising mixtures and their try-out in steel making is well under way. A report will be published shortly embodying the results of investigations to date A number of large steel manufacturers have become interested in the work and have already rendered valuable assistance in the preparation of the deoxidizers, and in trying them out.

Specifications for standard tests for welds.—Difference in details of procedure for testing welds have caused such widely divergent results that comparisons are frequently impossible, with the result that the usefulness of much of the research work on record is greatly restricted.

A preliminary report, embodying the standardization of procedure for making tests of welds, has been completed and published in the proceedings of the American Welding Society.

Specifications for steel to be welded.—The quality and composition of the base or parent metal has an important bearing on the quality of the resultant weld. This committee is, therefore, devoting its activities to a study of existing specifications for steel, with a view to determining their suitability for welding purposes and modifying such existing specifications wherever necessary.

Electric arc welding, resistance welding, and gas welding.—These committees are confining their activities for the present to the prepa-

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ration of critical summaries of existing knowledge and experience in the various branches of the welding field. The purpose of such summaries is to lay a sound foundation on which the much needed research may be properly planned.

Welding of storage tanks.—This committee was organized to meet the requests for information from the Standard Oil Co. as to the feasibility of welding storage tanks. Considerable difficulty has been experienced with the riveted tank, because such structures are not "oil-tight" for the lighter oils.

The result of this application of welding promises not only a cheaper but also a better storage tank, and will open a new and large field to which welding is particularly adapted. Several small tanks have already been built successfully in this way, although the designs were not specially adapted to welding. Specifications are in progress for the building of a large tank which will be constructed by the Standard Oil Co.

Training of welding operators.—The ultimate object of this committee is to draw up a standard for the training of welders which will meet the wide needs of the industry, varying from those of the manufacturer who is interested in one particular job to those at a shipyard and railroad, who are training men for all classes of work. Efforts for the present are confined to drawing up a set of questions designed for the special purpose of enabling the instructor to obtain a preliminary indication as to whether the prospective student has the necessary qualifications of becoming a good operator.

Welding wire specifications.—Specifications for welding wire by gas and electricity have been prepared by this committee for the welding of mild steel, and will be published shortly. Considerable progress has been made also in the preparation of specifications for a high-carbon electric-welding wire to meet the demands for the building up of worn surfaces where great resistance to abrasive wear is desired.

Core losses.—This committee was organized for the purpose of reducing core loss calculations of electrical machinery to a more rational basis. Four phases of this work are now being conducted at four universities—Harvard, Washington (St. Louis), Missouri, and Massachusetts Institute of Technology. Manufacturers have promised to cooperate and will furnish the services of their engineers and the facilities of their laboratories.

Highway advisory board.—Since the beginning of the year the advisory board on highway research, established through the activities of the division of engineering to organize a national program of highway research, has been seeking sufficient funds to employ a

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director and provide for the necessary office expenses. These funds are now in sight, and Prof. W. K. Hatt of Purdue University has been engaged to take charge on July 1. The committee on economic theory of highway improvement, one of the committees coming under this board, has secured the cooperation of eight or nine State highway departments in conducting a number of research projects relating to this subject. It is estimated that in this way not less than $250,000 will be made available for this work during the coming year.

NEW PROJECTS.

Molding sand research.—In cooperation with the American Foundrymen's Association, the division is organizing an investigation on the reclamation of used sands in molding operations and for other foundry use. A well-planned investigation in this field will undoubtedly yield information which will result in an annual saving of millions of dollars. A bibliography has been prepared and progress is being made in preparing a critical summary of existing knowledge which will serve as a basis for drawing up a carefully selected research program. The financial support comes largely from the American Foundrymen's Association.

Welded rail joints.—Welding is being used very widely in making rail joints, and several of the large electric railway companies each spend over $100,000 a year for this work. More or less trouble from breakage has been experienced in all types of welding in commercial use, and although much experimental work has been carried out by individual companies (both manufacturers and users), no satisfactory solution has been obtained. Realizing this need, the American Electric Railway Engineering Association has appealed to the Amercan Bureau of Welding (the welding advisory board of the division of engineering) for assistance in organizing a rail-welding research, with the assurance that the necessary financial support will be provided by the electric railway companies and by the manufacturers of welding equipment, several of these companies having already promised such support.

The provisional organization committee has already had one meeting and the organization is under way.

Marine borer research.—Owing to the very sudden increase in the destruction of marine piling in San Francisco Bay resulting from the attack of marine borers, and amounting to about $15,000,000 in the last year or two, there was organized a San Francisco Bay Marine Piling Committee of the American Wood Preservers' Association. This committee prepared a very elaborate report covering all available knowledge concerning this subject. It has also established a

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marine laboratory in San Francisco Bay for the purpose of furthering investigations, and has raised $30,000 for this purpose.

Realizing the danger of the spread of this activity to other parts of the coast line, the nation-wide importance of the problem and its solution and the need for the sponsorship of some recognized and unbiased national organization, the above-named committee appealed to the National Research Council for assistance in the organization of a national movement for the attack of this problem.

Accordingly a committee was appointed by the council, consisting of the chairmen of the divisions of engineering, of chemistry and chemical technology, and of biology and agriculture, to consider means for undertaking coordinated investigations upon the problem. This committee is now preparing a statement of the present situation in regard to the use of timber in marine construction and also a tentative program of investigations. It is hoped to secure the participation of all agencies concerned in the marine borer menace in carrying out this proposed extensive study.

This is one of the most important problems presented to the National Research Council since its organization and one of the best illustrations of the important service which can be rendered by a national body of this sort. It is also an excellent illustration of the need for cooperation between the scientific and engineering groups.

The problem is a decidedly imminent one and some attempt at a practical solution must be made immediately. This, however, does not preclude a more thorough investigation of the fundamentals involved looking toward the most effective and economical solution. Everything possible is being done to push this work along.

Revision of steam tables.—The best steam tables now available are recognized to be in error by a sufficient amount to warrant the very extensive research work necessary for a comprehensive revision. In fact, there are certain differences of opinion involving thermodynamic theory which can only be reconciled by careful experimental determination. Moreover, the present tables do not go high enough in temperature or pressure to meet the needs of modern steam engineering.

A movement is now under way to organize a national committee for this purpose, under the general advisory board on mechanical engineering of the division of engineering. This board is sponsored by the American Society of Mechanical Engineers. For the purpose of planning this organization a meeting of the most prominent steam engineers of the country was held in Cambridge, Mass., at the laboratory of the Harvard Engineering School, on Thursday, June 23. A report of the meeting will be available shortly. A small

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part of this experimental work has already been completed at the laboratory of the Harvard Engineering School, a part of the expense being borne by the university and part by the American Society of Mechanical Engineers.

DIVISION OF CHEMISTRY AND CHEMICAL TECHNOLOGY.

[F. G. COTTRELL, *Chairman.*]

(For present personnel see Appendix A.)

The committee on synthetic drugs, Julius Stieglitz, chairman, has been inactive during the past few months owing to the fact that but very few inquiries have been received. From this it would seem that the manufacture of synthetic drugs in this country has now returned to a normal basis, and, on recommendation of the chairman, the committee will not be continued for the ensuing year.

The committee on methods of organic analysis, C. G. Derick, chairman, has confined its activities up to the present to an educational campaign carried out by a few addresses by members of the committee on the value of qualitative organic analysis. The committee is considering the publication of a brief laboratory manual on this subject, and Mr. S. P. Mulliken, of the Massachusetts Institute of Technology, is also continuing his very valuable methods of analysis for organic compounds. It is hoped to get the committee into active cooperation with various universities in order that the needed research may be completed on methods of separation of organic compounds and of their identification.

The committee on pharmaceutical research, J. M. Francis, chairman, has met with many perplexities and it is not ready as yet to report a definite program. It is expected that in the near future a committee will be named to outline a proper plan of procedure.

The committee on the chemistry of colloids, H. N. Holmes, chairman, has vigorously continued its activities initiated at the beginning of the year. A number of lectures have been given by members of the committee before universities and local sections of the American Chemical Society, and the attendance at these lectures indicates a growing interest in colloid chemistry. W. D. Bancroft has completed and published a stimulating textbook on "Applied Colloid Chemistry," and the chairman expects to have his "Laboratory Manual" ready for publishing soon. Suggestions that the committee act as clearinghouse for colloid chemists and manufacturers have brought ready response, but it would seem that the vigorous development of colloid chemistry in this country is too recent to have created an adequate supply of men needed. The classified bibliography, which has been in course of preparation for some time, will soon be issued in mimeograph form and distributed

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for criticism and suggested additions, and a final edition will be published in some suitable manner later on. The list of 200 colloid problems, now being published in the Journal of Industrial and Engineering Chemistry, is another part of the general plan of the committee, and is calling forth decidedly interesting letters of inquiry.

The committee on ceramic research, Albert V. Bleininger, chairman, after a review of the present status of ceramic research, selected the following four subjects to receive the first attention: (1) A study of the elements which determine the plastic nature of clay; (2) a critical examination of certain methods used in silicate analysis; (3) a study of American pot clays and their proper compounding for the production of refractories used in the glass industry; (4) a study of the relationship between crazing and the expansion coefficients of bodies and glazes. These subjects were considered as especially promising and likely to attract the attention of the industries. The attitude of the makers of glass was very encouraging, and also of several firms engaged in the production of pots and blocks; but a number of other manufacturers of these clay products, however, declined to support the movement on the ground that such investigations should be conducted either with public funds, or, if supported privately, the results of the work should be kept confidential.

As several of the larger glass manufacturers had made their support contingent upon the cooperation of the manufacturers of glass house refractories, cooperative investigation did not appear promising and the matter was dropped for the time being. Manufacturers of pottery and other clay products were then approached with reference to the other subjects mentioned, but also with negative results. However, negotiations along these lines are still under way and it is believed that within the present year positive cooperation may result.

As the result of the efforts of the chairman of the committee a number of manufacturers of heavy structural clay products have become interested in cooperative research and an executive committee for several associations has been organized, and also a special technical committee; and a program has been outlined and the problems involved have been assigned to the members of the technical committee to be worked out in detail and specific plans outlined for attacking them. When this plan has been approved, research men will be employed who will have the status of fellows and will work at the various institutions under competent direction in prosecuting the investigation of specific problems. It is planned that the results of this cooperative research program shall be presented at the meetings of the heavy clay products division of the American

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Ceramic Society, and this division will constitute a clearing house for the various associations of manufacturers in handling the work and making recommendations as to its continuance from year to year.

The committee on explosives investigations, Charles E. Munroe, chairman, has continued the work on problems initiated last year. As a result of its work on the utilization of surplus military explosives the entire surplus of T. N. T. (21,000,000 pounds) has now been distributed over a wide area, and though much of it has been used by the inexpert not a single accident from fire, explosion, or poisoning attending its use has been reported, while the reports of its behavior are quite enthusiastic. The tests by experts of the best methods of using picric acid (there being a surplus of 12,000,000 pounds to dispose of) have been made and instructions for tests in the field have been prepared, but it is not thought safe to look upon the instructions as final until the results of field tests by the inexpert under the supervision of experts, which are now under way, have been carried out on a large scale.

The committee has prepared translations of several publications deemed of special value; and a cooperative arrangement has been made between the Ordnance Department, United States Army, the Bureau of Ordnance of the Navy, and the Bureau of Mines under which a translation relative to explosives or a cognate subject prepared for one of them is manifolded for transmission through this committee to the others. A special feature this year is a review of the files of the Bureau of Mines and a carding of all the reports of investigations of accidents from or outrages committed with explosives made from the foundation of that bureau, so that in future investigations this material may be readily accessible.

No report has been received from the committee on sewage disposal, Edward Bartow, chairman, but the committee has been continued for the ensuing year.

At the annual meeting of the division, held at Rochester, N. Y., April 27, it was decided to undertake the publishing of a list of research chemicals in this country, and a committee representing the division of chemistry and chemical technology and the research information service was appointed, as follows: Messrs. W. D. Collins (chairman), Roger Adams, Capt. D. B. Bradner, Messrs. H. T. Clarke, W. F. Hillebrand, George C. Spencer, Clarence J. West (secretary). Mr. West has already entered upon his duties and some 500 letters have been sent out to manufacturing chemists throughout the country, and so far about 100 replies have been received; these replies will be assembled and a draft or bulletin will be submitted to the members of the committee for approval in due course.

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At a meeting of the executive committee of the division, held in New York June 4, it was voted to take steps to secure the publication of information obtained through the development of our explosives industries and research connected therewith during the World War, and a committee representing the division of Federal relations and the division of chemistry and chemical technology was appointed for that purpose, consisting of Messrs. C. L. Alsberg, Charles E. Munroe, and Clarence J. West.

The following gentlemen have been appointed as delegates to the annual meeting of the International Union of Pure and Applied Chemistry, to be held at Brussels June 27, 1921: Messrs. F. G. Cottrell, E. S. Chapin, Frederick G. Keyes, Collin McCall, Hugh S. Taylor, and James B. Conant.

(With regard to progress in the matter of publication of critical tables of physical and chemical constants, see report of the division of research extension.)

DIVISION OF GEOLOGY AND GEOGRAPHY.

[EDWARD B. MATHEWS, *Chairman.*]

(For present personnel, see Appendix A.)

The outstanding features in the past six months in the division are: (1) The actual start of work on Mr. Wood's project for seismological study; (2) the completion of definite plans for cooperation between the American Geographical Society and the division in the publication of a series of maps of Africa; (3) the investigations of the committees of geography and sedimentation, presented at the annual meeting in April; (4) the completion and publication by the division of its investigations of the "status of geology and geography in the United States"; and (5) the beginning of a new office project, the collection of unpublished bibliographies on geology and geography. A brief summary of each of these to date follows:

1. PROJECT FOR SEISMOLOGICAL STUDY.

Early in 1919 Mr. H. O. Wood presented a very carefully considered scheme for seismological investigation. Prof. A. C. Lawson, of the University of California, also presented a somewhat similar project at a later date. After investigation by a committee of experts it was decided to push actively that portion of the project which dealt especially with southern California. Funds were not immediately forthcoming, but the Carnegie Institution of Washington early this year appointed Mr. Wood research associate and assigned him to this problem. Although the funds available are not as large as the plan originally called for, the division is exceedingly grateful to the institution for having made possible a start on the work. The region

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is a key region in the study of earthquakes. The investigation is certain to show "how frequently shocks occur, and how strong they are" and "the places of origin of special hazard"; it ought to show "where earth strain is growing and how, and perhaps how fast and why." In time prediction of earthquake shocks may become possible. The work is expected, in any event, to "make significant contribution to the dynamics of geology and the physics of the earth."

2. COOPERATION BETWEEN THE DIVISION AND THE AMERICAN GEOGRAPHICAL SOCIETY.

The American Geographical Society is one of the few strong instruments in this country for advancing geographical science. The division has been anxious to find ways in which it might be of assistance to this subject and finds in the publication of some of the results of the House "Inquiry" a very promising field of cooperation. An appropriation of $750 by the division and $1,000 by the society is at present being utilized in this work, the specific project at present under way being the preparation of general maps of Africa showing the distribution of soil types, vegetation zones, and land classification. These will represent "a great advance in accuracy and detail over former maps." It is hoped that the sale of these maps will provide a revolving fund for the publication of other maps embodying new knowledge.

The society has recently invited the cooperation of the division in a project calling for an examination and critical report on the condition of geographic science in the countries in Europe.

3. WORK OF GEOGRAPHY AND SEDIMENTATION COMMITTEES.

The committee on geography is interesting itself particularly at the present time in bringing about the production of a map of the United States more suitable than any extant for plotting the statistics of the Census Bureau in their relation to the physiographic divisions of the country. The smallest unit now employed by the bureau is the county, which is too gross to bring out these relations. If a township map were available it would be of great value, and the division is heartily seconding the efforts of the committee in its endeavor to procure such a map, especially for the northeastern United States where the difficulties of so doing are less. Already individual workers are awaiting the success of the project.

The committee on sedimentation has been making studies fundamental to opening the way for broad researches in sedimentation. In its recent report were presented outlines of studies in sedimentation being carried on in the universities of the United States, problems in sedimentation suggested by State geologists in response to a

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questionnaire, a review of studies on sediments being carried on by Federal institutions, a bibliography of chemical and physical researches on sediments, an outline for the field description of sedimentary rocks, including suggestions for standardizing color description, and a full outline for a treatise on sedimentation.

4. STUDY OF STATUS OF GEOLOGY AND GEOGRAPHY IN THE UNITED STATES.

This study, which has been carried on in the office more or less intensively since July, 1920, was completed early in the year. The completed paper appears in the Bulletin of the Geological Society of America and as No. 17 of Reprint and Circular Series of the National Research Council.

5. UNPUBLISHED BIBLIOGRAPHIES.

The division has recently inaugurated a new project, that of obtaining lists of unpublished bibliographies. A list of such bibliographies, made available by publication as soon as possible, should be of much value in preventing duplication of time by research students in the same field. Responses to a circular letter requesting information have been generous and all replies have been decidedly sympathetic to the idea. Several manuscript bibliographies of much value have already been discovered and the project gives promise of meeting a real need.

Various other activities of the division have been carried on as usual. Coordination of effort and cooperation between individuals and organizations have been fostered, and research students have been put in touch with others of similar interests. Probably at no time since its organization has the division been more successful in these types of activity. The chairman of the division has continued cooperation with the United States Board of Surveys and Maps, thereby keeping in close touch with both Government and public map requirements and problems.

Altogether the past six months are felt to have marked a considerable advance in the usefulness of the division.

DIVISION OF MEDICAL SCIENCES.

[G. W. McCOY, *Chairman.*]

(For present personnel see Appendix A.)

Owing to the splendid cooperation of the members of the executive committee of the division of medical sciences, it has been possible to carry on the work of the division for the half year with but a single meeting of the division. This meeting was held on April 11 in Washington. The work of the year was reviewed and the outlook for the future carefully canvassed.

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It was the consensus of opinion of the members that while the larger projects of the division had not found financial support, the formulation of the projects was worth the time and effort given to it since there resulted the presentation of detailed plans for important work, which plans had secured the approval of the division.

A single large new project that contemplated the investigation of conditions affecting the health of people growing out of the prevailing undernutrition in central Europe was formulated by a committee of experts which met at Boston. This project called for an outlay of about $65,000 a year and had in view the carrying out of studies of metabolism, studies of epidemology, and infectious diseases and those of a psychological nature. Thus far no source of funds has been found.

A relatively small project for the aiding of studies in empyema has been given financial aid in the way of providing for financing studies on pathological material and for the analysis of X-ray findings now at the disposal of research workers through the courtesy of the Surgeon General of the Army. The division has participated in several activities jointly with the division of anthropology and psychology, as follows:

1. Conference on problems of the welfare of women and children which might profitably be studied in certain institutions in Washington.

2. Conference on the functions of the semicircular canals with special reference to tests for aviators.

3. Conference between selected groups of psychologists and psychiatrists with a view to promoting a better understanding of problems that fall on the border line between these groups of practitioners and if possible defining the field of each.

Provision has been made for a conference jointly with the division of biology and agriculture on contagious abortion of farm animals, a step of great economic importance, but related to the division of medical sciences only by reason of the affiliation of the American Veterinary Association with the division.

The chairman represented the division at the meeting of the Association for the Advancement of Science in Chicago in January and at the meeting of the American Medical Association in Boston in January.

DIVISION OF BIOLOGY AND AGRICULTURE.

[C. E. McCLUNG, *Chairman.*]

(For present personnel, see Appendix A.)

The activities of the division of biology and agriculture for the first six months of the calendar year 1921–22 have largely been a

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continuation of efforts begun earlier. An analytical review of these has been made and will here be briefly considered.

1. In a study of the conditions under which biological and agricultural research is conducted in this country, there has spontaneously arisen in several instances the suggestion that the one thing most needed are research institutes free from the obligations of elementary instruction and from the requirements of immediately practical results. This matter was considered further by the division and provision made for a careful study of the problem.

2. Along with this consideration of a specific agency for promoting research there has come also in the case of several subjects a broad survey of present conditions and the formulation of programs for future development. Some of these are already resulting in definite accomplishment and will be referred to under other headings.

3. Such considerations led naturally to surveys of existing institutions. So far these have concerned only marine biological laboratories and inland aquatic laboratories. Recently, at a conference held at Fairport, Iowa, under the authority of the Department of Commerce, one session was given to a consideration of the development and correlation of inland laboratories. This matter will be pursued further, with the hope that a system of stronger institutions, concerned in each case with special subjects, may be developed.

4. Discussions of research conditions led naturally to the suggestion of other agencies for the promotion of research. Among these were mentioned a bureau of methods, files of current problems, standardization of biological reagents, establishment of a research fellowship system, and assistance to publications. A committee has been at work for more than a year on the problem of preparing and publishing lists of problems, and this has received favorable consideration by the division. Efforts to promote the standardization of biological reagents have not accomplished any definite results but will be continued. The committee on fellowships made a definite report recommending the policy of research fellowships both for the promotion of research and for the development of investigators. It is hoped that the money will be forthcoming for the inauguration of such a system. Continued efforts to secure support for publications have not yet been successful. However, it is hoped that within the next year progress will be made toward the establishment of a listing and bibliographical system under the auspices of the council.

5. The relation of the council to the industries is a subject which has been constantly up for study. As has been indicated in earlier reports, the division has been instrumental in helping in the establishment of a Crop Protection Institute, in providing the American Institute of Baking with scientific advice, in assisting the Mulford Expedition to South America, and in carrying out a study on the con-

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tamination of food products. In several instances, industrial associations have approached the council for assistance in the development of research agencies and in carrying out specific investigations. These have all been sympathetically received.

6. One of the most difficult problems which the division has faced has been in securing assistance for individual investigators. There has always been some uncertainty about the desirability of doing this, but, as a matter of trial, several individual investigators have been assisted. So far these efforts have all resulted satisfactorily. In some instances the assistance has been provided by securing financial support for the individual and in others by securing from his institution relief from routine work so that he might devote himself to a special investigation.

7. Another form of assistance in research projects considered is that of cooperative effort in the solution of a particular problem. There has already been reported the study of physiological salt requirements of cultivated plants which is being continued and which promises to give definite scientific and practical results. There is also the case of the study of protein requirements of animals begun during the war. This has resulted in an extended report, a summary and discussion of which will soon be published by the council. In this case the collaborators will be free to publish from their own institutions the detailed results of their investigations, while the council, through the chairman of the committee, will publish the digest and summary. The cooperative study under the direction of the committee on forestry is proceeding actively and it is anticipated that valuable results will soon be ready for publication.

Naturally such cooperative investigations suggested themselves in relation to large comprehensive problems where the time and training of the individual investigator is not sufficient to enable him to accomplish the work desired. It would appear that in such cases as this the promotion of cooperative investigations should be one of the most valuable features of the council's work. Among such suggested investigations are those upon the conservation of meadows and pastures, oceanographic studies, and ecological study of the air. These are all under consideration and a committee has been provided for the last mentioned. The Ecological Society of America has a large committee which is making a study of existing areas of the country which it is desired to preserve for future biological study in an undisturbed condition. This committee has been actively at work for some time but its efforts have been crippled by a lack of financial support. Accordingly, on recommendation of the division of biology and agriculture, the council has provided money for the further prosecution of the work of this committee.

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8. It was the hope that in establishing the council a definite means would be provided for better mutual understandings between workers in different fields of science. The various divisions of the council were set up so as to bring together the most nearly related sciences, thus providing for intimate association, and then means within the council were provided for contacts between representatives of these groups of science. The large amount of time required for organization within the divisions and for the council as a whole has in a way prevented the full development of relations between these different divisions. However, in several instances our division has entered into cooperation with the others of the council. There may be mentioned here the work with the division of research extension in forming the Crop Protection Institute and in providing the advisory board for the American Institute of Baking. Recently there has been occasion for cooperation with the engineering division and the division of chemistry and chemical technology in developing a project for the study of the marine borer in San Francisco Bay. With the cooperation of the division of physical sciences, also, there is arranged a conference on biophysics to be held at Woods Hole this summer. Outside of the council the particular contact of the division has been with the United States Department of Agriculture.

9. One of the most valuable features of the council's organization is the opportunity which it gives for bringing together groups of individuals particularly interested in some subject. Such conferences are essential to the full understanding of a problem and for the mutual adaptations between individuals required for their successful prosecution. Reference has already been made in previous reports to such conferences upon the condition of science in the Philippines, to conferences of committees on agronomy, horticulture, food and nutrition, fertilizers, and phytopathology. At the present time, in cooperation with the division of medical sciences, arrangements are being made for similar conferences upon the very serious animal disease called contagious abortion.

10. Another form of outside contact is with organizations having purposes similar to the council. Reference has already been made to the Second International Eugenics Congress to be held in New York in September of this year. This is now well organized and gives promise of being very successful. The Sigma Xi Society is an organization in universities devoted to the promotion of scientific research. For a number of years it has had under consideration a plan to establish a system of research fellowships. Lack of financial support has made this difficult to start, and so the council voted a small sum of money to get this under way. Already this has resulted in the collection of a sufficient sum of money to establish at

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least two research fellowships comparable to those in physics and chemistry under the research fellowship board of the council. The Marine Biological Laboratory at Woods Hole is an outstanding example of cooperative effort within a scientific group, and because of this the council has lent its support in an effort to increase the facilities of the laboratory. While no definite results have been obtained as yet, there is reason to believe that eventually we should be able to assist this national cooperative laboratory.

11. The results of the war have placed upon American science increased responsibilities, especially in the matter of the publication of scientific work. Continued efforts have been made to assist in this matter, and the council has contributed directly to the support of Botanical Abstracts. Also it has made a small contribution to the Wistar Institute at Philadelphia to assist in the wider dissemination of certain zoological and anatomical journals which it published in the desire to extend more widely the influence of American biology and also to promote international good will by placing these journals for a time free of charge in laboratories where they would not otherwise go.

12. It was hoped that the establishment of the National Research Council, representing the scientific forces of the country, would provide a definite agency for giving expression to the collective judgments of scientific groups. In a measure the success of the council would be in the degree to which it was appealed to for an expression of such group judgments. Already there is satisfactory evidence that the council is thus recommending itself. Through the division of biology and agriculture it has been asked to express its judgment upon a number of important scientific projects which have sought financial support from different foundations.

DIVISION OF ANTHROPOLOGY AND PSYCHOLOGY.

[CLARK WISSLER, *Chairman.*]

(For present personnel, see Appendix A.)

This division has initiated a number of important conferences. two of which were held during the period—one conference on vestibular research and one on the relation of psychology to medical practice. Both were financed by an appropriation from the council amounting in the aggregate to $1,150.

The former revealed a distinct need for a standing committee. which was later authorized by the council. As now organized this committee comprises the leading investigators in this field, all of whom are actually engaged in research. For the support of these investigations the council has appropriated $1,400. Mention should also be made of the generosity of the University of California in

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appropriating $400 for vestibular investigations by its representative on the committee. A number of other institutions have signified their intention to cooperate in the near future. The ultimate objective of the research is an understanding of the nervous mechanism by which equilibrium of the pilot of an airplane is maintained.

The conference on the relations of psychology to medicine was attended by six representatives of the medical profession and an equal number of psychologists, and concerned itself with the psychological training in medical schools and the legal status of psychological advisers and practitioners. This proved a very successful conference and promises to make for progress in this important problem.

During the interval the division was called upon to consider a number of extensive plans for research and make recommendations on the same. Since several of these requests referred to problems of fundamental importance, the division was able to render a real service.

The project for the prediction of success of students entering higher institutions was completed during the period, $500 having been appropriated by the council last year for that purpose. The project for the encouragement of research talent was taken up by the division of educational relations and will be reported under that head. The encouragement of State archæological surveys has proceeded under the direction of the special committee on that subject. Progress has been made in Indiana, Michigan, Iowa, and Illinois, the chairman of the division having held conferences with representatives from these States.

The annual meeting of the division was held on April 22, 1921.

APPENDIX A.

OFFICERS, MEMBERS, AND COMMITTEES.

OFFICERS AND EXECUTIVE BOARD.

OFFICERS.

Honorary chairman, George E. Hale, director of the Mount Wilson Observatory, Carnegie Institution of Washington, Pasadena, Calif.

Chairman, H. A. Bumstead,[1] professor of physics and director of the Sloane Physical Laboratory, Yale University, New Haven, Conn.

First vice chairman, Charles D. Walcott, Secretary of the Smithsonian Institution; president of the Academy of Sciences, Washington, D. C.

Second vice chairman, Gano Dunn, president of the J. G. White Engineering Corporation, 43 Exchange Place, New York City.

Third vice chairman, R. A. Millikan, professor of physics, University of Chicago, Chicago, Ill.

[1] Deceased.

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Permanent secretary, Vernon Kellogg, National Research Council, Washington, D. C.

Treasurer, F. L. Ransome, geologist in charge, section of metalliferous deposits, United States Geological Survey; treasurer of the National Academy of Sciences, Washington, D. C.

By reciprocal arrangement with the Engineering Foundation—

Assistant secretary, Alfred D. Flinn, secretary of the Engineering Foundation, 29 West Thirty-ninth Street, New York City.

EXECUTIVE BOARD.

Chairman, H. A. Bumstead.[1]

MEMBERS EX OFFICIO.

Officers of the council.

President of the National Academy of Sciences, Charles D. Walcott, Secretary of the Smithsonian Institution, Washington, D. C.

Home secretary of the National Academy of Sciences, C. G. Abbot, director of the Atrophysical Observatory, Smithsonian Institution, Washington, D. C.

President of the American Association for the Advancement of Science, Eliakim H. Moore, professor of mathematics, University of Chicago, Chicago, Ill.

Past chairmen of the National Research Council: George E. Hale, director of the Mount Wilson Observatory, Carnegie Institution of Washington, Pasadena, Calif.; John C. Merriam, president of the Carnegie Institution of Washington, Washington, D. C.; James R. Angell, president of the Carnegie Corporation, 522 Fifth Avenue, New York City.

Chairmen of the divisions of general relations.

Chairmen and vice chairmen of the divisions of science and technology.

MEMBERS AT LARGE.

Edward D. Adams, vice chairman of the Engineering Foundation, 71 Broadway, New York City.

John J. Carty, vice president of the American Telephone & Telegraph Co., 195 Broadway, New York City.

Gano Dunn, president of the J. G. White Engineering Corporation, 43 Exchange Place, New York City.

Van H. Manning, director of the division of research, American Petroleum Institute, 15 West Forty-fourth Street, New York City.

R. A. Millikan, professor of physics, University of Chicago, Chicago, Ill.

A. A. Noyes, director of chemical research, California Institute of Technology, Pasadena, Calif.

Raymond Pearl, professor of biometry and vital statistics, Johns Hopkins University, Baltimore, Md.

M. I. Pupin, professor of electro-mechanics, Columbia University, New York City.

S. W. Stratton, director of the United States Bureau of Standards, Washington, D. C.

C. P. Townsend, patent attorney, Washington, D. C.

William H. Welch, director of the School of Hygiene and Public Health, Johns Hopkins University, Baltimore, Md.

R. S. Woodward, trustee of the Carnegie Institution of Washington, Washington, D. C.

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[1] Deceased.

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ADMINISTRATIVE COMMITTEES OF THE COUNCIL.

Committee on budget (joint committee with National Academy of Sciences): Chairman, Charles D. Walcott; H. A. Bumstead,[1] F. L. Ransome.

Committee on building plans (joint committee with National Academy of Sciences): Chairman, George E. Hale; H. A. Bumstead,[1] Gano Dunn, H. E. Howe, Vernon Kellogg, John C. Merriam, R. A. Millikan, A. A. Noyes, Augustus Trowbridge, Charles D. Walcott, with H. S. Pritchett in an advisory capacity, representing the Carnegie Corporation.

Committee on building stone with reference to new building (joint committee with National Academy of Sciences): Chairman, Charles D. Walcott; H. A. Bumstead,[1] Vernon Kellogg, John C. Merriam.

Committee on finance: Chairman, H. A. Bumstead;[1] John J. Carty, Gano Dunn, George E. Hale, H. E. Howe, Vernon Kellogg, John C. Merriam.

Committee on organization and budget: Chairman, H. E. Howe; Vernon Kellogg, F. L. Ransome.

Project committee: Chairman, H. A. Bumstead;[1] Vernon Kellogg, F. L. Ransome.

Promotion committee: Chairman, H. E. Howe; Paul Moore.

Committee on publication: Chairman, Robert M. Yerkes; H. A. Bumstead,[1] Vernon Kellogg.

Committee on publicity: Chairman, Vernon Kellogg; H. E. Howe, Robert M. Yerkes.

TECHNICAL COMMITTEES OF THE COUNCIL.

Committee to confer with committee of American Association for the Advancement of Science on bibliography: Chairman, Robert M. Yerkes; Vernon Kellogg, C. E. McClung.

Committee on conservation of natural resources: Chairman, John C. Merriam; J. McKeen Cattell, John M. Clarke, Vernon Kellogg, C. E. McClung.

Committee to consider various phases of industrial research: Chairman, Gano Dunn; Comfort A. Adams, John J. Carty, George E. Hale, H. E. Howe.

Committee on Federal grants for research: Chairman, Vernon Kellogg; John J. Carty, Gano Dunn, S. W. Stratton, Charles D. Walcott, Robert M. Yerkes.

Committee on industrial personnel research: Chairman, H. A. Bumstead;[1] secretary, Alfred D. Flinn; Comfort A. Adams, James R. Angell, W. V. Bingham, S. P. Capen, H. E. Howe, George W. McCoy, Beardsley Ruml, Robert M. Yerkes.

Committee on Patent Office: Chairman, L. H. Baekeland, honorary professor of chemical engineering, Columbia University, New York City; secretary, Edwin J. Prindle, 111 Broadway, New York City; W. F. Durand, Thomas Ewing, Frederick P. Fish, Reid Hunt, R. A. Millikan, M. I. Pupin, S. W. Stratton, C. P. Townsend.

Committee on proposed journal of scientific instruments: Chairman, Augustus Trowbridge; H. E. Howe, Robert M. Yerkes, Gano Dunn.

Trustees for the publication of critical tables of physical and chemical constants: Chairman, Hugh K. Moore, manager of the research laboratory, Brown Co., Berlin, N. H.; George P. Adamson, H. E. Howe, Edward P. Hyde, Julius Stieglitz.

Editorial board for publication of critical tables of physical and chemical constants: G. K. Burgess, Saul Dushman, John Johnston, C. E. K. Mees, C. E. Mendenhall, R. B. Moore.

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[1] Deceased.

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Executive committee of the American Geophysical Union (acting also as the American section of the International Geodetic and Geophysical Union): Chairman, William Bowie, Chief of the Division of Geodesy, United States Coast and Geodetic Survey, Washington, D. C.; L. A. Bauer, F. G. Cottrell, Arthur L. Day, W. J. Humphreys, G. W. Littlehales, C. F. Marvin, E. B. Mathews, C. E. McClung, R. A. Millikan, H. F. Reid, Augustus Trowbridge, H. S. Washington.

Representative of the National Research Council in the Crop Protection Institute, H. E. Howe, chairman of the division of research extension, National Research Council, Washington, D. C.

Representatives of the Council on—

Editorial Board of Proceedings of National Academy of Sciences: Member of the executive committee, Vernon Kellogg; members of the editorial board, the chairman and permanent secretary of the Council, C. A. Adams, F. G. Cottrell, C. E. McClung, E. B. Mathew, G. W. McCoy, R. A. Millikan, F. L. Ransome, Augustus Trowbridge, R. M. Yerkes.

Board of trustees of Science Service: George E. Hale, Vernon Kellogg, R. M. Yerkes.

DIVISIONS OF THE COUNCIL.

I. Division of Federal Relations.

Chairman, Charles D. Walcott.
Vice chairman, C. L. Alsberg.
Secretary, Augustus Trowbridge.

EXECUTIVE COMMITTEE.

Chairman, C. L. Alsberg; Charles D. Walcott; Col. Colden L'H. Ruggles, George Otis Smith, S. W. Stratton, Augustus Trowbridge.

MEMBERS OF THE DIVISION.

EX OFFICIO.

Robert M. Yerkes, chairman, Research Information Service, National Research Council, Washington, D. C.

The President of the United States, on the recommendation of the president of the National Academy of Sciences, acting as chairman of the division of Federal relations of the National Research Council, has designated the following representatives of the various departments to act as members of this division:

DEPARTMENT OF STATE.

Wilbur J. Carr, Director of the Consular Service.

DEPARTMENT OF THE TREASURY.

J. W. Schereschewsky, Assistant Surgeon General, Public Health Service.

DEPARTMENT OF WAR.

Lieut. Col. Edward T. Donnelly, General Staff, United States Army.

Brig. Gen. Dennis E. Nolan, General Staff, Director of the Military Intelligence Division, United States Army.

Col. Clarence H. McNeil, Coast Artillery, United States Army.

Col. Joseph S. Siler, Medical Corps, United States Army.

Lieut. Col. Clarence O. Sherrill, Engineer Corps, United States Army.

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Col. Colden L'H. Ruggles, Ordnance Department, United States Army.
Maj. Gen. George O. Squier, Chief Signal Officer, United States Army.
Maj. Byron Q. Jones, Air Service, United States Army.
Brig. Gen. A. A. Fries, Chief of the Chemical Warfare Service, United States Army.

DEPARTMENT OF JUSTICE.

——— ———.

DEPARTMENT OF THE NAVY.

——— ———, Intelligence Division, Office of Naval Operations, United States Navy.
Rear Admiral J. A. Hoogewerff, Superintendent of the Naval Observatory, Bureau of Navigation, United States Navy.
Rear Admiral C. W. Parks, Chief of the Bureau of Yards and Docks, United States Navy.
Capt. C. C. Bloch, Acting Chief of the Bureau of Ordnance, United States Navy.
Rear Admiral D. W. Taylor, Chief Constructor of the Navy and Chief of the Bureau of Construction and Repair, United States Navy.
Rear Admiral R. S. Griffin, Chief of the Bureau of Engineering, United States Navy.
Rear Admiral Edward R. Stitt, Surgeon General and Chief of the Bureau of Medicine and Surgery, United States Navy.

DEPARTMENT OF THE INTERIOR.

William A. Kinnan, classification examiner, Patent Office.
——— ———, Bureau of Education.
George Otis Smith, Director of the Geological Survey.
A. P. Davis, Director of the Reclamation Service.
H. Foster Bain, Director of the Bureau of Mines.

DEPARTMENT OF AGRICULTURE.

C. F. Marvin, Chief of the Weather Bureau.
J. R. Mohler, Chief of the Bureau of Animal Industry.
Karl F. Kellerman, physiologist and Associate Chief of the Bureau of Plant Industry.
E. H. Clapp, assistant forester, Forest Service.
C. L. Alsberg, Chief of the Bureau of Chemistry.
Milton Whitney, Chief of the Bureau of Soils.
L. O. Howard, entomologist and Chief of the Bureau of Entomology.
E. W. Nelson, biologist and Chief of the Bureau of Biological Survey.
T. H. MacDonald, Chief of the Bureau of Public Roads.

POST OFFICE DEPARTMENT.

——— ———.

DEPARTMENT OF COMMERCE.

Joseph A. Hill, chief statistician, Bureau of the Census.
S. W. Stratton, Director of the Bureau of Standards.
Hugh M. Smith, commissioner, Bureau of Fisheries.
William Bowie, Chief of the Division of Geodesy, Coast and Geodetic Survey.

DEPARTMENT OF LABOR.

Ethelbert Stewart, commissioner, Bureau of Labor Statistics.

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SMITHSONIAN INSTITUTION.

Charles D. Walcott, Secretary of the Smithsonian Institution and president of the National Academy of Sciences, Washington, D. C.

COMMITTEES.

Committee on relations between scientific agencies in State and Federal Governments (joint committee with division of States relations): Chairman of the section of the division of Federal relations and chairman of the joint committee, E. W. Allen, Chief of the Office of Experiment Stations, United States Department of Agriculture, Washington, D. C.

Committee on scope of government service: Chairman, C. L. Alsberg.

II. Division of Foreign Relations.

Chairman, R. A. Millikan.
Vice chairman, Wilbur J. Carr.
Vice chairman, H. A. Bumstead.[1]

EXECUTIVE COMMITTEE.

Chairman, R. A. Millikan; vice chairmen, Wilbur J. Carr and H. A. Bumstead;[1] William Bowie, Vernon Kellogg, John C. Merriam, W. S. Thayer.

MEMBERS OF THE DIVISION.

NATIONAL ACADEMY OF SCIENCES, EX OFFICIO.

Charles D. Walcott, president of the National Academy of Sciences; Secretary of the Smithsonian Institution, Washington, D. C.

R. A. Millikan, foreign secretary of the National Academy of Sciences, professor of physics, University of Chicago, Chicago, Ill.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Burton E. Livingston, professor of plant physiology and director of laboratory of plant physiology, Johns Hopkins University; permanent secretary of the American Association for the Advancement of Science, Washington, D. C.

AMERICAN ACADEMY OF ARTS AND SCIENCES.

A. A. Noyes, director of chemical research, California Institute of Technology, Pasadena, Calif.

AMERICAN PHILOSOPHICAL SOCIETY.

Henry Fairfield Osborn, president of the trustees of the American Museum of Natural History, New York City.

DEPARTMENT OF STATE.

Wilbur J. Carr, Director of the Consular Service, United States Department of State, Washington, D. C.

INTERNATIONAL ASTRONOMICAL UNION.

W. W. Campbell, vice president of the International Astronomical Union; chairman of the executive committee of American section; director of Lick Observatory, University of California, Mount Hamilton, Calif.

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[1] Deceased.

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INTERNATIONAL GEODETIC AND GEOPHYSICAL UNION.

William Bowie, president of the section on geodesy, International Geodetic and Geophysical Union; chairman of the American Geophysical Union; chairman of the section on geodesy; Chief of the Division of Geodesy, United States Coast and Geodetic Survey. Washington, D. C.

C. F. Marvin, secretary of the section on meteorology, International Geodetic and Geophysical Union; chairman of the section on meteorology, American Geophysical Union; Chief of the United States Weather Bureau, Washington, D. C.

Louis A. Bauer, secretary of the section on terrestrial magnetism and electricity, International Geodetic and Geophysical Union; vice chairman of the American Geophysical Union; chairman of the section on terrestrial magnetism and electricity; director of the department of terrestrial magnetism, Carnegie Institution of Washington, Washington, D. C.

G. W. Littlehales. member of the executive committee, section on physical oceanography, International Geodetic and Geophysical Union; chairman of the section on physical oceanography, American Geophysical Union; hydrographic engineer, United States Hydrographic Office, Washington, D. C.

H. S. Washington, vice president of the section on volcanology, International Geodetic and Geophysical Union; chairman of the section on volcanology. American Geophysical Union; petrologist, Geophysical Laboratory, Carnegie Institution of Washington. Washington, D. C.

INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY.

F. G. Cottrell, chairman of the division of chemistry and chemical technology, National Research Council, Washington, D. C.

INTERNATIONAL MATHEMATICAL UNION.

L. E. Dickson, professor of mathematics, University of Chicago, Chicago, Ill.

INTERNATIONAL UNION OF SCIENTIFIC RADIO TELEGRAPHY.

Louis Austin, head of United States Naval Radio Research Laboratory, Washington. D. C.

INTERNATIONAL BUREAU OF WEIGHTS AND MEASURES.

S. W. Stratton, director of the United States Bureau of Standards, Washington, D. C.

INTERNATIONAL STANDARDIZATION COMMISSION.

Comfort A. Adams, chairman of the American committee; Lawrence professor of engineering, Harvard University; chairman of the division of engineering, National Research Council, 29 West Thirty-ninth Street, New York City.

INTERNATIONAL ELECTROTECHNICAL COMMISSION.

C. O. Mailloux, president of the United States National Committee, 111 Fifth Avenue. New York City.

INTERNATIONAL COMMISSION ON ILLUMINATION.

Edward P. Hyde, Nela Research Laboratory, General Electric Co., Nela Park, Cleveland, Ohio.

EX OFFICIO.

Chairman of the National Research Council and chairmen of all divisions.

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MEMBERS AT LARGE.

H. A. Bumstead,[1] professor of physics and director of the Sloane Physical Laboratory, Yale University; chairman of the National Research Council, Washington, D. C.

Herbert Hoover, Secretary of Commerce; trustee of Leland Stanford Junior University, Stanford University, Calif.

Elihu Root, 31 Nassau Street, New York City.

W. S. Thayer, professor of clinical medicine, Johns Hopkins University, Baltimore, Md.

COMMITTEE.

Committee on Pacific Investigations: Chairman, H. E. Gregory, Silliman professor of geology, Yale University, New Haven, Conn.

III. Division of States Relations.

Chairman, John C. Merriam.
Secretary, Albert L. Barrows.

EXECUTIVE COMMITTEE.

Chairman, John C. Merriam; Frank W. DeWolf, Vernon Kellogg, A. F. Woods.

MEMBERS OF THE DIVISION.

John C. Merriam, president of the Carnegie Institution of Washington, Washington, D. C.

DIVISION OF EDUCATIONAL RELATIONS.

Vernon Kellogg, chairman of the division, National Research Council, Washington, D. C.

DIVISION OF RESEARCH EXTENSION.

H. E. Howe, chairman of the division, National Research Council, Washington, D. C.

RESEARCH INFORMATION SERVICE.

Edwin F. Gay, president of New York Evening Post (Inc.), New York City.

DIVISION OF PHYSICAL SCIENCES.

Ernest Merritt, professor of physics and head of the department of physics, Cornell University, Ithaca, N. Y.

DIVISION OF ENGINEERING.

S. W. Stratton, director of the United States Bureau of Standards, Washington, D. C.

DIVISION OF CHEMISTRY AND CHEMICAL TECHNOLOGY.

Wilder D. Bancroft, professor of physical chemistry, Cornell University, Ithaca, N. Y.

DIVISION OF GEOLOGY AND GEOGRAPHY.

E. B. Mathews, chairman of the division; professor of mineralogy and petrography, Johns Hopkins University; State geologist of Maryland; director of the State weather service, Baltimore, Md.

[1] Deceased.

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DIVISION OF MEDICAL SCIENCES.

V. C. Vaughan, professor of hygiene and physiological chemistry, and dean of the medical school, University of Michigan, Ann Arbor, Mich.

DIVISION OF BIOLOGY AND AGRICULTURE.

A. F. Woods, president of the University of Maryland, College Park, Md.

DIVISION OF ANTHROPOLOGY AND PSYCHOLOGY.

J. Walter Fewkes, chief of the Bureau of American Ethnology, Smithsonian Institution, Washington, D. C.

ASSOCIATION OF AMERICAN STATE GEOLOGISTS.

Frank W. DeWolf, State geologist of Illinois, Urbana, Ill.

SOCIETY OF AMERICAN FORESTERS.

Hugh P. Baker, secretary-treasurer of the American Paper and Pulp Association, 18 East Forty-first Street, New York City.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS.

Paul D. Sargent, chief engineer, highway commission, Augusta, Me.

MEMBERS AT LARGE.

E. A. Birge, president of the University of Wisconsin, Madison, Wis.

John M. Clarke, State geologist and paleontologist; director of the State museum, Education Building, Albany, N. Y.

H. E. Gregory, Silliman professor of geology, Yale University; superintendent of the geological and natural history survey of Connecticut, New Haven, Conn.

Van H. Manning, director of the division of research, American Petroleum Institute, 15 West Forty-fourth Street, New York City.

T. S. Palmer, expert in game conservation, United States Biological Survey, Washington, D. C.

James A. B. Scherer, Pasadena, Calif.

Henry Suzzallo, president of the University of Washington, Seattle, Wash.

COMMITTEE.

Committee on relations between scientific agencies in State and Federal Governments (joint committee with division of Federal relations): Chairman of the section of the division of States relations, Vernon Kellogg.

IV. Division of Educational Relations.

Chairman, Vernon Kellogg.
Secretary, Albert L. Barrows.

EXECUTIVE COMMITTEE.

Chairman, Vernon Kellogg; S. P. Capen, Donald J. Cowling, Graham Edgar, Abraham Flexner, A. Ross Hill, John C. Merriam, A. F. Woods.

MEMBERS OF THE DIVISION.

Vernon Kellogg, permanent secretary of the National Research Council, Washington, D. C.

AMERICAN ASSOCIATION OF LAND GRANT COLLEGES.

A. F. Woods, president of the University of Maryland, College Park, Md.

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AMERICAN ASSOCIATION OF UNIVERSITY PROFESSORS.

E. W. Brown, professor of mathematics, Yale University, New Haven, Conn.

AMERICAN COUNCIL ON EDUCATION.

S. P. Capen, director of the American Council on Education, Washington, D. C.

ASSOCIATION OF AMERICAN COLLEGES.

Donald J. Cowling, president of Carleton College, Northfield, Minn.

ASSOCIATION OF AMERICAN UNIVERSITIES.

A. Ross Hill, president of the University of Missouri, Columbia, Mo.

NATIONAL ASSOCIATION OF STATE UNIVERSITIES.

Frank L. McVey, president of the University of Kentucky, Lexington, Ky.

UNITED STATES BUREAU OF EDUCATION.

George F. Zook, specialist in higher education, United States Bureau of Education, Washington, D. C.

RESEARCH FELLOWSHIP BOARD OF THE NATIONAL RESEARCH COUNCIL.

Simon Flexner, chairman of the board; director of research laboratories, Rockefeller Institute for Medical Research, Sixty-sixth Street and Avenue A, New York City.

MEMBERS AT LARGE.

F. B. Dains, professor of chemistry, University of Kansas, Lawrence, Kans.

W. F. Durand, professor of mechanical engineering, Leland Stanford Junior University, Stanford University, Calif.

Graham Edgar, professor of chemistry, University of Virginia, University, Va.

Abraham Flexner, secretary of the General Education Board, 61 Broadway, New York City.

H. E. Gregory, Silliman professor of geology, Yale University, and superintendent of the geological and natural history survey of Connecticut, New Haven, Conn.

Herbert Hoover, Secretary of Commerce, trustee of Leland Stanford Junior University, Stanford University, Calif.

John C. Merriam, president of Carnegie Institution of Washington, Washington, D. C.

H. S. Pritchett, president of the Carnegie Foundation for the Advancement of Teaching, 522 Fifth Avenue, New York City.

Lieut. Col. Robert I. Rees, General Staff, chief of the education and recreation branch of the War Plans Division, United States Army, Washington, D. C.

Robert M. Yerkes, chairman of the research information service, National Research Council, Washington, D. C.

L. R. Jones, liaison member from the division of biology and agriculture, professor of plant pathology, University of Wisconsin, Madison, Wis.

V. Division of Research Extension.

Chairman, H. E. Howe.
Vice chairman, W. M. Corse.
Secretary, Paul Moore.

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EXECUTIVE COMMITTEE.

Chairman, H. E. Howe; vice chairman, W. M. Corse; F. G. Cottrell, C. E. K. Mees, C. P. Townsend.

MEMBERS OF THE DIVISION.

W. M. Corse, general manager of the Monel Metal Products Co., Bayonne, N. J.

EX OFFICIO.

Augustus Trowbridge, chairman of the division of physical sciences, National Research Council; professor of physics, Princeton University, Princeton, N. J.

Comfort A. Adams, Lawrence professor of engineering, Harvard University; chairman of division of engineering, National Research Council, 29 West Thirty-ninth Street, New York City.

F. G. Cottrell, chairman of division of chemistry and chemical technology, National Research Council, Washington, D. C.

C. E. McClung, chairman of the division of biology and agriculture, National Research Council; professor of zoology and director of the zoological laboratory, University of Pennsylvania, Philadelphia, Pa.

BUREAU OF MINES.

R. B. Moore, chief chemist and chief of the division of mineral technology, United States Bureau of Mines, Washington, D. C.

BUREAU OF CHEMISTRY.

F. P. Veitch, chemist in charge of leather and paper laboratory, United States Bureau of Chemistry, Washington, D. C.

BUREAU OF STANDARDS.

G. K. Burgess, chief of the metallurgical division, United States Bureau of Standards, Washington, D. C.

MEMBERS AT LARGE.

L. H. Baekeland, honorary professor of chemical engineering, Columbia University, New York City.

John J. Carty, vice president of the American Telephone & Telegraph Co., 195 Broadway, New York City.

Alfred D. Flinn, secretary of the Engineering Foundation, 29 West Thirty-ninth Street, New York City.

W. A. Hamor, assistant director of the Mellon Institute, Pittsburgh, Pa.

H. E. Howe, National Research Council, Washington, D. C.

John Johnston, Sterling professor of chemistry, Yale University, New Haven, Conn.

C. E. K. Mees, director of development and research, Eastman Kodak Co., Rochester, N. Y.

A. R. Pierce, Pierce Manufacturing Co., New Bedford, Mass.

Walter Rautenstrauch, professor of mechanical engineering, Columbia University, New York City.

F. K. Richtmyer, professor of physics, Cornell University, Ithaca, N. Y.

C. P. Townsend, patent attorney, Washington, D. C.

E. W. Washburn, professor of ceramic chemistry and head of the department of ceramic engineering, University of Illinois, Urbana, Ill.

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COMMITTEE.

Advisory committee on alloys research: Chairman, W. M. Corse.

VI. RESEARCH INFORMATION SERVICE.

Chairman, Robert M. Yerkes.
Vice chairman, Edwin F. Gay.

EXECUTIVE COMMITTEE.

Chairman, Robert M. Yerkes; vice chairman, Edwin F. Gay; Alfred D. Flinn; C. E. McClung, Charles L. Reese, Augustus Trowbridge.

MEMBERS OF THE DIVISION.

EX OFFICIO.

Chairman of the National Research Council and chairmen of all divisions.

DEPARTMENT OF STATE.

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DEPARTMENT OF THE TREASURY.

J. W. Schereschewsky, assistant Surgeon General, United States Public Health Service, Washington, D. C.

DEPARTMENT OF WAR.

Brig. Gen. Dennis E. Nolan, General Staff, director of the Military Intelligence Division, United States Army, Washington, D. C.

DEPARTMENT OF JUSTICE.

Frank Burke, chief of the United States Bureau of Investigation, Washington, D. C.

POST OFFICE DEPARTMENT.

Joseph Stewart, special assistant to the Attorney General, United States Post Office Department, Washington, D. C.

DEPARTMENT OF THE NAVY.

Rear Admiral W. S. Smith, United States Navy, Washington, D. C.

DEPARTMENT OF THE INTERIOR.

Thomas T. Read, chief of the Division of Educational Information, Bureau of Mines, Washington, D. C.

DEPARTMENT OF AGRICULTURE.

C. L. Alsberg, chief of the United States Bureau of Chemistry, Washington, D. C.

DEPARTMENT OF COMMERCE.

S. W. Stratton, director of the United States Bureau of Standards, Washington, D. C.

DEPARTMENT OF LABOR.

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A. G. Mayor, director of the department of marine biology, Carnegie Institution of Washington, Tortugas, Fla. (276 Nassau Street, Princeton, N. J.)

Henry F. Moore, Deputy Commissioner of the United States Bureau of Fisheries, Washington, D. C.

J. R. Murlin, professor of physiology, and director of the department of vital economics, University of Rochester, Rochester, N. Y.

Wilfred H. Osgood, assistant curator of mammalogy and ornithology, Field Museum of Natural History, Chicago, Ill.

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Walter T. Swingle, physiologist in charge, crop physiology and breeding investigations, United States Bureau of Plant Industry, Washington, D. C.

A. F. Woods, president of the University of Maryland, College Park, Md.

COMMITTEES.

Advisory Board of the American Institute of Baking: Chairman, Harry E. Barnard, director, American Institute of Baking, Minneapolis, Minn.

Committee on cooperation and coordination: Chairman, F. R. Lillie.

Committee on educational relations: Chairman, L. R. Jones.

Committee on Eugenics: Chairman, C. B. Davenport, director of the eugenics record office, eugenics laboratory, Carnegie Institution of Washington, Cold Spring Harbor, N. Y.

Committee on fellowships: Chairman, M. F. Guyer.

Committee on fertilizers: Chairman, J. G. Lipman, director of the New Jersey Agricultural Experiment Station, New Brunswick, N. J.

Subcommittee on physiological salt requirements of cultivated plants: Chairman, A. G. McCall, professor of geology and soils, University of Maryland, College Park, Md.

Committee on food and nutrition: Chairman, J. R. Murlin.

Subcommittee on animal nutrition: Chairman, H. P. Armsby, director of the institute of animal nutrition, Pennsylvania State College, State College, Pa.

Subcommittee on human nutrition: Chairman, J. R. Murlin.

Committee on forestry: Chairman, Raphael Zon, forest economist, United States Forest Service, Washington, D. C.

Committee on marine biological laboratory: Chairman, F. R. Lillie.

Committee on oceanography: Chairman, Henry F. Moore.

Committee on phytopathology: Chairman, George R. Lyman.

Committee on phytopathology in the Tropics: Chairman, W. A. Orton, plant pathologist, United States Bureau of Plant Industry, Washington, D. C.

Committee to secure list of current problems: Chairman, G. N. Collins.

COMMITTEES OF SCIENTIFIC SOCIETIES IN COOPERATION WITH THE DIVISION.

American Society of Agronomy: Chairman, Charles V. Piper.

Society of American Bacteriologists: Chairman, Samuel C. Prescott.

Botanical Society of America: Chairman, N. L. Britton, director in chief of the New York Botanical Garden, Bronx Park, New York City.

Ecological Society of America: Chairman, Barrington Moore.

American Association of Economic Entomologists: Chairman, Walter C. O'Kane, professor of economic entomology, New Hampshire College of Agriculture and Mechanic Arts, Durham, N. H.

American Society for Horticultural Science: Chairman, U. P. Hedrick.

American Society of Naturalists: Chairman, Bradley M. Davis, professor of botany, University of Michigan, Ann Arbor, Mich.

American Society of Zoologists: Chairman, F. R. Lillie.

XIII. Division of Anthropology and Psychology.

Chairman, Clark Wissler.

Vice chairman, C. E. Seashore.

EXECUTIVE COMMITTEE.

Chairman, Clark Wissler; vice chairman, C. E. Seashore; R. B. Dixon, Raymond Dodge, J. Walter Fewkes, E. L. Thorndike.

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MEMBERS OF THE DIVISION.

AMERICAN ANTHROPOLOGICAL ASSOCIATION.

R. B. Dixon, professor of anthropology, Harvard University, Cambridge, Mass.

J. Walter Fewkes, chief of the Bureau of American Ethnology, Smithsonian Institution, Washington, D. C.

F. W. Hodge, Museum of the American Indian, Broadway at One hundred and fifty-fifth Street, New York City.

A. L. Kroeber, curator of anthropology, Museum of Anthropology; professor of anthropology, University of California, Berkeley, Calif.

Berthold Laufer, curator of anthropology, Field Museum of Natural History. Chicago, Ill.

Clark Wissler, curator of anthropology, American Museum of Natural History, New York City.

AMERICAN PSYCHOLOGICAL ASSOCIATION.

James R. Angell, president of the Carnegie Corporation, 522 Fifth Avenue, New York City.

Raymond Dodge, professor of psychology, Wesleyan University, Middletown, Conn.

C. E. Seashore, dean of the graduate college, and professor of psychology, State University of Iowa, Iowa City, Iowa.

H. C. Warren, Stuart professor of psychology, Princeton University, Princeton, N. J.

J. B. Watson, Baltimore, Md.

G. M. Whipple, professor of experimental education, University of Michigan. Ann Arbor, Mich.

MEMBERS AT LARGE.

J. H. Breasted, professor of egyptology and oriental history, University of Chicago, Chicago, Ill.

S. I. Franz, scientific director, Government Hospital for the Insane, Washington, D. C.

P. E. Goddard, curator of ethnology, American Museum of Natural History. New York City.

L. M. Terman, professor of education, Leland Stanford Junior University, Stanford University, Calif.

E. L. Thorndike, professor of educational psychology, Teachers' College, Columbia University, New York City.

A. M. Tozzer, associate professor of anthropology and curator of middle American archeology and ethnology, Peabody Museum of American Archeology and Ethnology, Harvard University, Cambridge, Mass.

A representative of the division of Federal relations.

COMMITTEES.

Committee on anthropological and psychological study of the people of the United States: Chairman, Clark Wissler.

Committee on archeological survey of the States of Illinois, Indiana, Iowa, and Missouri: Chairman, R. B. Dixon.

State subcommittee for Indiana: Chairman, Amos W. Butler.

State subcommittee for Illinois: Chairman, Berthold Laufer.

State subcommittee for Iowa: Chairman, B. F. Shambaugh.

Committee on child welfare research: Chairman, Clark Wissler.

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Committee on initiation of a journal of psychological abstracts (joint committee with the American Psychological Association): Chairman, C. E. Seashore.

Advisory committee on problems of military psychology: Chairman, Walter Dill Scott, Northwestern University, Evanston, Ill.

Committee on national intelligence tests: Chairman, G. M. Whipple.

Committee on nystagmus research: Chairman, Clark Wissler.

Committee on organized search for research talent among college students: Chairman, C. E. Seashore.

Committee on personnel research in business and industry: Chairman, Beardsley Ruml, assistant to the president of the Carnegie Corporation, 522 Fifth Avenue, New York City.

Committee on prediction of success of students entering higher institutions: Chairman, W. V. Bingham, professor of applied psychology, Carnegie Institute of Technology, Pittsburgh, Pa.

Committee on specific projects outside of the United States: Chairman, J. Walter Fewkes.

Committee of the National Association of Directors of Educational Research to cooperate with the division: Chairman, M. E. Haggerty, professor of educational psychology, University of Minnesota, Minneapolis, Minn.

Representative of the division on committee on health examinations of the American Physical Education Association: E. A. Hooton, Peabody Museum, Harvard University, Cambridge, Mass.

Research Fellowship Board.

A sum, amounting to $500,000 for the period May 1, 1919, to June 30, 1925, has been pledged to be appropriated by the Rockefeller Foundation to the National Research Council for the maintenance of National Research fellowships in physics and chemistry, under the direction of a research fellowship board appointed by the council of the National Academy of Sciences and the executive board of the National Research Council acting jointly.

The members appointed on this board serve for a period of five years. With them the chairmen of the divisions of physical sciences and of chemistry and chemical technology, appointed annually, serve in an ex officio capacity.

MEMBERS OF THE BOARD.

Simon Flexner, chairman, director of research laboratories, Rockefeller Institute for Medical Research, Sixty-sixth Street and Avenue A, New York City.

K. T. Compton, assistant professor of physics, Princeton University, Princeton, N. J.

George E. Hale, director of the Mount Wilson Observatory, Carnegie Institution of Washington, Pasadena, Calif.

Elmer P. Kohler, professor of chemistry, Harvard University, Cambridge, Mass.

R. A. Millikan, professor of physics, University of Chicago, Chicago, Ill.

A. A. Noyes, director of chemical research, California Institute of Technology, Pasadena, Calif.

EX OFFICIO.

F. G. Cottrell, chairman of the division of chemistry and chemical technology, National Research Council, Washington, D. C.

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Augustus Trowbridge, professor of physics, Princeton University; chairman of the division of physical sciences, National Research Council; executive secretary of the research fellowship board for 1920–21, Washington, D. C.

Fellowships for 1920–21 have been awarded to the following persons, who have demonstrated a high order of ability in research, for the purpose of enabling them to conduct investigations at educational institutions which make adequate provision for research in physics and chemistry:

IN CHEMISTRY.

James A. Beattie
Arthur F. Benton
Francis W. Bergstrom
F. Russell Bichowsky
Frederick L. Browne
Emmett K. Carver
George L. Clark
Edwin J. Cohn
Roscoe G. Dickinson
Rolla N. Harger
Selig Hecht
Martin C. Henke
David C. Jones
Morris Kharasch
Albert G. Loomis
John P. Minton
Axel R. Olson
Henry C. Parker
Worth H. Rodebush

IN PHYSICS.

Ernest F. Barker
Gregory Breit
John S. Foster
Paul S. Helmick
Leonard B. Loeb
John P. Minton
George P. Paine
Henry DeW. Smyth
Louis T. E. Thompson
Joseph Valasek

APPENDIX B.

ARTICLES OF ORGANIZATION AS AMENDED UP TO JUNE 30, 1921.

PREAMBLE.

The National Academy of Sciences, under the authority conferred upon it by its charter enacted by Congress, and approved by President Lincoln on March 3, 1863, and pursuant to the request expressed in an Executive order made by President Wilson on May 11, 1918, adopts the following articles of organization for the National Research Council, to replace the temporary organization under which it has operated heretofore:

ARTICLE I—PURPOSE.

It shall be the purpose of the National Research Council to promote research in the mathematical, physical, and biological sciences, and in the application of these sciences to engineering, agriculture, medicine, and other useful arts, with the object of increasing knowledge, of strengthening the national defense, and of contributing in other ways to the public welfare, as expressed in the Executive order of May 11, 1918.

ARTICLE II—MEMBERSHIP.

SECTION 1. The membership of the National Research Council shall be chosen with the view of rendering the council an effective federation of the principal research agencies in the United States concerned with the fields of science and technology named in Article I.

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SEC. 2. The council shall consist of representatives of national scientific and technical societies; representatives of the Government, as provided in the Executive order; and representatives of other research organizations and other persons whose aid may advance the objects of the council.

ARTICLE III—DIVISIONS.

SECTION 1. The council shall be organized in divisions of two classes: Divisions dealing with the more general relations and activities of the council, and divisions dealing with special branches of science and technology.

SEC. 2. The initial constitution of the divisions of the council shall be as follows:

Divisions of general relations: Division of Federal relations, division of foreign relations, division of States relations, division of educational relations, division of research extension, and research information service.

Divisions of science and technology: Division of physical sciences, division of engineering, division of chemistry and chemical technology, division of geology and geography, division of medical sciences, division of biology and agriculture, and division of anthropology and psychology.

SEC. 3. The number of divisions and the grouping of subjects in Article III, section 2, may be modified by the executive board of the National Research Council.

SEC. 4. The divisions of general relations shall be organized by the executive board of the National Research Council. (Art. IV, sec. 2.)

SEC. 5. To secure the effective federation of the principal research agencies in the United States, provided for in Article II, a majority of the members of each of the divisions of science and technology shall consist of representatives of scientific and technical societies, who shall be chosen as provided for in Article V, section 2. The other members of the division shall be nominated by the executive committee of the division, approved by the executive board of the National Research Council, and appointed in accordance with Article V, section 4.

SEC. 6. The divisions of the council, with the approval of the executive board, may establish sections and committees, any of which may include members chosen outside the membership of the council.

ARTICLE IV—ADMINISTRATION.

SECTION 1. The affairs of each division shall be administered by a chairman, one or more vice chairmen, and an executive committee, of which the chairman and vice chairmen shall be ex officio members. The officers and the executive committee of each of the divisions of general relations shall be appointed by the executive board for such periods as may be determined by the board, except that the foreign secretary of the National Academy of Sciences shall be ex officio chairman of the division of foreign relations. The officers and executive committee of each of the divisions of science and technology shall be elected by the division at its annual meeting and confirmed by the executive board.

SEC. 2. The affairs of the National Research Council shall be administered by an executive board, of which the officers of the National Research Council, the president and home secretary of the National Academy of Sciences, the president of the American Association for the Advancement of Science, the chairmen and vice chairmen of the divisions of science and technology, and the chairmen of the divisions of general relations shall be members ex officio. In the absence of the chairman of a division the vice chairman or other executive officer shall represent him. The council of the National Academy of

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Sciences and the executive board of the National Research Council, acting jointly, may nominate additional members, not to exceed 12 in number, who, if not already members of the National Research Council, shall be appointed thereto by the president of the National Academy of Sciences for terms of three years. Upon their retirement chairmen of the National Research Council shall continue as members of the executive board for two years beyond the period of their appointment. Subject to the approval of the executive board the business of the council may be transacted by an interim committee constituted as defined in the by-laws.

SEC. 3. The officers of the National Research Council shall consist of a chairman, a chairman of the executive board, one or more vice chairmen, a permanent secretary, and a treasurer, who shall also serve as members and officers of the executive board of the council.

SEC. 4. The officers of the National Research Council, excepting the permanent secretary and the treasurer, shall be elected annually by the executive board. The permanent secretary of the council shall be elected by the executive board for a period of one year or more. The treasurer of the National Academy of Sciences shall be ex officio treasurer of the National Research Council.

SEC. 5. The duties of the officers of the council and of the divisions shall be fixed by the executive board.

ARTICLE V—NOMINATIONS AND APPOINTMENTS.

SECTION 1. The Government bureaus, civil and military, to be represented in the division of Federal relations and the scientific and technical societies, to be represented in the divisions of science and technology of the National Research council, shall be determined by joint action of the council of the National Academy of Sciences and the executive board of the National Research Council.

SEC. 2. Representatives of scientific and technical societies shall be nominated by the societies, at the request of the executive board, and appointed by the president of the National Academy of Sciences to membership in the council and assigned to one of its divisions.

SEC. 3. The representatives of the Government shall be nominated by the president of the National Academy of Sciences after conference with the secretaries of the departments concerned, and the names of those nominated shall be presented to the President of the United States for designation by him for service with the National Research Council.

SEC. 4. Other members of the council shall be nominated by the executive committees of the divisions, approved by the executive board, and appointed by the president of the National Academy of Sciences to membership and assigned to one of the divisions.

SEC. 5. Members of the council shall be appointed for terms of three years, except when appointed to fill unexpired terms.

SEC. 6. The Government representatives shall serve for periods of three years, unless they previously retire from the Government office which they represent, in which case their successors shall be appointed for the unexpired term.

ARTICLE VI—MEETINGS.

SECTION 1. Meetings of the council may be held on call of the executive board.

SEC. 2. The executive board and the divisions shall hold annual meetings, at which, in the case of the divisions of science and technology, officers shall be elected; such other meetings may be called as may be required for the transaction of business. The annual meeting of the executive board shall be held in

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April in the city of Washington, on a date to be determined as the board may direct.

SEC. 3. Joint meetings of the executive board of the National Research Council and the council of the National Academy of Sciences shall be held from time to time, to consider any matters which, in the judgment of the president of the National Academy, require the attention of both bodies.

ARTICLE VII—PUBLICATIONS AND REPORTS.

SECTION 1. An annual report on the work of the National Research Council shall be presented by the chairman to the National Academy of Sciences for submission to Congress in connection with the annual report of the president of the academy.

SEC. 2. Other publications of the National Research Council may include papers, bulletins, reports, and memoirs, which may appear in the proceedings or memoirs of the National Academy of Sciences, in the publications of other societies, in scientific and technical journals, or in a separate series of the Research Council.

ARTICLE VIII—AMENDMENTS.

SECTION 1. Power of amendment of these articles of organization shall reside in the council of the National Academy of Sciences.

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ANNUAL REPORT OF THE TREASURER.

[January 1 to June 30, 1921.]

To the President of the National Academy of Sciences:

I have the honor to submit the following report as treasurer of the academy for the six months' period from January 1 to June 30, 1921, and as treasurer of the National Research Council for the same period. At the autumn meeting of the academy, held in November, 1920, the constitution and rules were amended so as to change the termination of the fiscal year from December 31, as heretofore, to June 30. This report is divided into two sections, the first covering the accounts of the National Academy of Sciences and the second covering those of the National Research Council.

NATIONAL ACADEMY OF SCIENCES.

The total income of the academy from gifts, dues, interest on investments, subscriptions, and contributions to proceedings amounted to $25,775.16. The miscellaneous disbursements amounted to $12,846.35, and payments on grants and for medals from trust funds amounted to $5,304.92.

The total book value of the investments held by the academy on June 30, 1921, was $256,051.50, yielding interest at that date at the rate of 5.27 per cent on the sum named. The market value of these investments on June 30, 1921, as nearly as could be determined, was $222,363.08 and the interest rate as computed on that sum was 6.07 per cent.

A gift of $400 was received from Mrs. Mary Clark Thompson, which was in addition to the $11,000 contributed by her during the year 1919. The additional sum was to provide for the award this year of the Mary Clark Thompson gold medal, which otherwise would not have been possible.

Special contributions, chiefly from members of the academy and amounting to $3,171, were secured through the efforts of Dr. Charles D. Walcott for the purpose of financing in a more satisfactory way the cost of publishing the Proceedings of the academy.

The capital of the Bache fund was increased by $1,000, making a total now for that fund of $60,000, by action of the directors of the Bache fund in transferring the sum of $1,000 from income to capital.

Changes in the investments may be summarized as follows: Loans on real estate aggregating $9,000 were paid at maturity. Nine bonds of a total face value of $6,700 were purchased for $6,465.50.

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The consolidated investment fund now totals $175,745.50, an increase of $1,000 having been made since the last report by the increase in the capital of the Bache fund.

TRUST FUNDS OF THE ACADEMY.

The trust funds of the academy, the income of which is administered for specific purposes, are enumerated below. The capital of certain funds has been increased beyond the amount of the original gift or bequest by the transfer of accumulated income at the request of the donors or by action of the academy.

Bache fund: Bequest of Alexander Dallas Bache, a member of the academy, 1870. To aid researches in physical and natural sciences	$60,000.00
Watson fund: Bequest of James C. Watson, a member of the academy, 1874. For the promotion of astronomical science through the award of the Watson gold medal and grants of money in aid of research	25,000.00
Draper fund: Gift of Mrs. Henry Draper, 1883. In memory of her husband, a former member of the academy. To found the Henry Draper gold medal, to be awarded for notable investigations in astronomical physics. The balance of income is applied to air research in the same science	10,000.00
Smith fund: Gift of Mrs. J. Lawrence Smith, 1884. In memory of her husband, a former member of the academy. To found the J. Lawrence Smith gold medal, to be awarded for important investigations of meteoric bodies and to assist, by grants of money, researches concerning such objects	10,000.00
Gibbs fund: Established by gift of Wolcott Gibbs, a member of the academy, 1892, and increased by a bequest of the late Morris Loeb, 1914. For the promotion of researches in chemistry	5,545.50
Gould fund: Gift of Miss Alice Bache Gould, 1897. In memory of her father, a former member of the academy. For the promotion of researches in astronomy	20,000.00
Comstock fund: Gift of Gen. Cyrus B. Comstock, a member of the academy, 1907. To promote researches in electricity, magnetism, or radiant energy through the Comstock prize of money, to be awarded once in five years for notable investigations. The fund is to be increased, ultimately, to $15,000	12,406.02
Marsh fund: Bequest of Othniel Charles Marsh, a member of the academy, 1909. To promote original research in the natural sciences. To the original bequest of $10,000 the academy has added interest received from the estate and has authorized the increase of the fund to $20,000 by annual additions from income	20,000.00
Murray fund: A gift from the late Sir John Murray, 1911. To found the Alexander Agassiz gold medal, in honor of a former member and president of the academy, to be awarded for original contribution to the science of oceanography	6,000.00
Hartley fund: A gift from Mrs. Helen Hartley Jenkins, 1913–14, in memory of her father, Marcellus Hartley, to found the medal of the academy awarded for eminence in the application of science to the public welfare	1,200.00

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Billings fund: Established by the bequest of Mrs. Mary Anna Palmer Draper (Mrs. Henry Draper) of $25,000, 1915. To support the publication of the proceedings of the academy or for other purpose, to be determined by the academy, three installments $5,000.00

Elliot fund: Gift of Margaret Henderson Elliot, to found the Daniel Giraud Elliot gold medal and honorarium for the most meritorious work in zoology or paleontology published in each year 8,000.00

Thompson fund: Gift of Mrs. Mary Clark Thompson, 1919, the income thereof to be applied for a gold medal of appropriate design to be awarded annually by the academy for the most important services to geology and paleontology, the medal to be known as the Mary Clark Thompson gold medal 10,000.00

In addition to the above-named funds the academy holds the following: Agassiz fund—bequest of Alexander Agassiz, a member of the academy, 1910, for the general uses of the academy ... 50,000.00

Total 243,151.52

Statement of assets and liabilities, June 30, 1921.

ASSETS.

	Face value.	Book value.	Market value June 30, 1921.
1. Mortgage notes, secured by first mortgages on real estate.....	$21,500.00	$21,500.00	$21,500.00
2. BONDS—			
(Bonds purchased during the year are indicated thus *.)			
American Telephone & Telegraph Co., 30-year, 5 per cent, gold collateral trust, due Dec. 1 1946; Nos. 4604, 29245, 29246, 41419; 4 at $1,000.....	4,000.00	3,817.50	3,280.00
Asheville Power & Light Co., first mortgage, 30-year gold, 5 per cent, due Apr. 1, 1942, New York; Nos. 272, 490, 492, 508, 509; 5 at $1,000..	5,000.00	4,892.50	3,750.00
Broadway Realty Co., purchase money, first 5 per cent gold, due Sept. 1, 1926; Nos. 50, 796, 963–965, 1068, 1616–1620, 1102, 1139, 1629, 1630; 15 at $1,000.....	15,000.00	14,930.00	12,750.00
Bush Terminal Buildings Co., first mortgage 50-year sinking fund, 5 per cent, gold, due Apr. 1, 1960; Nos. 1383–1387 and 2805–2809; 10 at $1,000.....	10,000.00	9,375.00	7,400.00
Chesapeake & Ohio, general mortgage, 4.5 per cent, gold, due New York, Mar. 1, 1992; Nos. 15350–15354; 5 at $1,000.....	5,000.00	4,600.00	3,650.00
City of Tacoma, Green River special water fund No. 2, 5 per cent, due Oct. 1, 1939; Nos. 1508–1511; 4 at $1,000.....	4,000.00	4,140.00	3,480.00
Cleveland Electric & Illuminationg Co., first mortgage, 5 per cent, gold, due New York, Apr. 1, 1939; Nos. D261–D264; 4 at $500; and Nos. M6060, M6096, M6097, M15094–M15098; 8 at $1,000.....	10,000.00	9,597.50	8,500.00
Commonwealth Electric Co., first 5 per cent, due June 1, 1943; Nos. 2945–2947, 4011; 4 at $1,000.....	4,000.00	3,600.00	3,160.00
Cosmos Club, 4.5 per cent, due July 1, 1949; Nos. 286–289, 290–294, 296, 297, 299, 301, 303–305, 350; 17 at $1,000.....	17,000.00	17,000.00	12,750.00
Detroit Edison Co., first and refunding mortgage, gold, 5 per cent, due Jan. 1, 1940; Nos. 9657–9660; 4 at $1,000, and Nos. D501, D502, D599; 3 at $500.....	5,500.00	5,005.00	4,200.00

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Statement of assets and liabilities, June 30, 1921—Continued.

ASSETS—Continued.

	Face value.	Book value.	Market value June 30, 1921.
2. BONDS—Continued.			
Detroit Edison Co., first mortgage, 30-year gold, 5 per cent, due Jan. 1, 1933; Nos. 557, 2442, 2443, 3024, 3252, 3253, 3639–3641, 8086; 10 at $1,000	$10,000.00	$10,072.50	$8,800.00
Dominion Coal Co. (Ltd.), first mortgage, sinking fund, gold, 5 per cent, due New York, Mar. 1, 1940; Nos. A1037–A1039; 3 at $1,000	3,000.00	2,718.75	2,340.00
Galveston, Harrisburg & San Antonio, Mexican and Pacific Ex., 6 per cent, second guaranteed; reduced to 5 per cent, due Jan. 1, 1931; Nos. 1044, 1048, 1248, 2112–2116; 8 at $1,000	8,000.00	8,030.00	6,560.00
Georgia Ry. & Electric Co., first consolidated mortgage, 5 per cent, sinking fund, gold, due Jan. 1, 1932; Nos. 191, 1061, 1600; 3 at $1,000	3,000.00	2,995.00	2,430.00
Government of the Province of Alberta, 4.5 per cent, 10-year gold debenture, due New York, Dec. 1, 1923; Nos. 1501–1511; 11 at $100, and Nos. 2031, 2032; 2 at $500	2,100.00	2,012.25	1,869.00
Government of the Province of Alberta, 4.5 per cent, 10-year gold debenture, due New York, Feb. 1, 1924; No. 2620; 1 at $500	500.00	470.00	445.00
Government of the Province of Alberta, 5 per cent, 10-year gold debenture, due New York, May 1, 1925; No. 2364; 1 at $1,000, and Nos. O189B–O193B; 5 at $500	3,500.00	3,380.00	3,150.00
Grand Rapids Gas Light Co., 5 per cent, first mortgage, gold, due New York, Aug. 1, 1939; Nos. A522, A523, A595, A596; 4 at $1,000	4,000.00	4,020.00	3,400.00
Great Northern Ry. Co.,* 7 per cent, 15-year general mortgage, series A, due July 1, 1936; temporary certificates; Nos. TM67750–TM67755; 6 at $1,000; TC4849, TC4850; 2 at $100; TD3817; 1 at $500	6,700.00	6,465.50	6,465.50
Hydraulic Power Co. of Niagara Falls, 5 per cent, refunding and improvement mortgage, due Oct. 1, 1951; Nos. D457, D458, D244; 3 at $500	1,500.00	1,320.00	1,200.00
Liberty, third loan, 4¼ per cent, gold, of 1928; Nos. 8239, at $10,000; Nos. 2643499–2643523; 25 at $100; and Nos. 4070782–4070787; 6 at $50.	12,800.00	12,800.00	11,617.28
Liberty, fourth loan, 4¼ per cent, gold, of 1933–1938; Nos DO4770174; EO4770175; 2 at $100	200.00	200.00	173.80
Michigan Northern Power Co., first mortgage guaranteed, 5 per cent, due 1941; Nos. 5054, 5057, 5216, 5516, 5567–5571, 8515; 10 at $1,000; and Nos. 4367, 4368; 2 at $500	11,000.00	9,540.00	8,250.00
Milwaukee Electric Ry. & Light Co., 5 per cent, general and refunding mortgage, gold, series A, due New York, Dec. 1, 1951; Nos. 2088, 2772, 3830, 3840, 3930, 3931, 5222–5224; 9 at $1,000	9,000.00	8,237.50	6,210.00
Minneapolis General Electric Co., 5 per cent, 30-year, gold mortgage, due New York, Dec. 1, 1934; Nos. 1621, 1622, 1949, 2004, 2572–2575, 7579, 7580; 10 at $1,000	10,000.00	9,880.00	8,700.00
Niagara Falls Power Co., first mortgage, 5 per cent, gold, coupon, due Jan. 1, 1932; Nos. 5246, 5247, 6583, 8358; 4 at $1,000	4,000.00	4,100.00	3,440.00
Niagara Falls Power Co., first mortgage, 5 per cent, gold, registered, due Jan. 1, 1932; No. R484; 1 at $6,000	6,000.00	5,760.00	5,160.00
Riggs Realty Co., 3–30-year coupon, first, 5 per cent, due Washington, D. C., Oct. 1, 1940; Nos. 124, 128, 132, 136, 140, 144; 6 at $1,000	6,000.00	6,195.00	5,520.00
Shawinigan Water & Power Co., 5 per cent, consolidated mortgage, 30-year, gold, due Jan. 1, 1934; Nos. MO354, MO510, M2894, M2943; 4 at $1,000	4,000.00	3,822.50	3,480.00

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Statement of assets and liabilities, June 30, 1921—Continued.

ASSETS—Continued.

	Face value.	Book value.	Market value June 30, 1921.
2. BONDS—Continued.			
Southern Bell Telephone & Telegraph Co., 30-year first mortgage, 5 per cent, sinking fund, gold, due Jan. 1, 1941; Nos. M9739, M11576–M11579, M13965, M15568–M15570; 9 at $1,000	$9,000.00	$8,942.50	$7,200.00
Swiss Government, 8 per cent, due July 1, 1940; No. 3400; 1 at $1,000	1,000.00	1,000.00	1,045.00
Trinity Buildings Corporation, first mortgage, gold, 5½ per cent, due 1939; Nos. M5229–M5243; 15 at $1,000; and Nos. D697–D706; 10 at $500	20,000.00	19,900.00	18,000.00
Two Rector Street Corporation, first mortgage, 15-year, sinking fund, gold loan, 6 per cent, due Apr. 1, 1935; No. M300; 1 at $1,000; No. D152; 1 at $500	1,500.00	1,500.00	1,327.50
Union Electric Light & Power Co., of St. Louis, 5 per cent, first mortgage, 30-year, gold, due New York, Sept. 1, 1932; Nos. 1352, 4169, 8601, 3821; 4 at $1,000	4,000.00	3,782.50	3,280.00
United Kingdom of Great Britain and Ireland, 10-year, 5½ per cent, due Aug. 1, 1929; Nos. M138584–M138599; 16 at $1,000	16,000.00	15,400.00	14,120.00
Vicksburg, Shreveport & Pacific R. R. Co., prior-lien mortgage, at 6 per cent, gold, renewed at 5 per cent, due Nov. 1, 1915, extended to Nov. 1, 1940; Nos. 561, 661, 794, 982, 1323; 5 at $1,000	5,000.00	5,050.00	3,750.00
Total	262,800.00	256,051.50	222,363.06

SUMMARY.

Book value of mortgage notes as above	$21,500.00
Book value of bonds as above	234,551.50
	256,051.50
Bank balance June 30, 1921	21,280.50
Total	277,332.00

LIABILITIES.

	Income.	Capital.		Income.	Capital.
General fund, uninvested	$973.91		Draper fund:		
Agassiz fund, invested		$50,000.00	Invested	$917.50	$10,000.00
Bache fund:			Uninvested	655.06	
Invested		60,000.00	Elliot fund:		
Uninvested	1,234.39		Invested	300.00	8,008.00
Billings fund, invested	50.00	5,000.00	Uninvested	674.96	
Building site:			Gibbs fund:		
Invested	2,240.00		Invested	500.00	5,545.50
Uninvested	479.95		Uninvested	36.89	
Comstock fund:			Gould fund:		
Invested	500.00	12,265.00	Invested	7,010.00	17,992.50
Uninvested	1,601.68	141.02	Uninvested	897.72	2,007.50
Consolidated fund, uninvested	1,310.25		Hale lectureship:		
			Invested	200.00	
			Uninvested	44.83	

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Statement of assets and liabilities, June 30, 1921—Continued.

LIABILITIES—Continued.

	Income.	Capital.		Income.	Capital.
Hartley fund:			Thompson fund:		
Invested		$1,200.00	Invested		$10,000.00
Uninvested	$130.68		Uninvested	$20.86	
Marsh fund:			Watson fund:		
Invested	$150.00	$20,000.00	Invested	1,780.00	24,976.25
Uninvested	1,215.09		Uninvested	1,104.71	23.75
Murray fund:			Grand total	34,180.48	243,151.52
Invested	400.00	6,000.00			
Uninvested	777.23		Consolidated investment fund:		
Proceedings:			Invested		174,227.75
Academy account, uninvested	1,125.76		Uninvested	1,310.25	1,517.75
Joint account, uninvested	1,977.42		Total	1,310.25	175,745.50
Emergency fund proceedings, uninvested	2,040.00				
Smith fund:					
Invested	2,542.50	10,000.00			
Uninvested	1,288.49				

Condensed statement of receipts and expenditures, Jan. 1 to June 30, 1921.

RECEIPTS.

Balance, Jan. 1, 1921, as per last report			$13,650.61
Cash receipts:			
Academy Proceedings—			
Annual dues	$1,035.00		
Subscriptions	167.00		
Reprints and separates	465.57		
Special contributions secured by Dr. Chas. D. Walcott	3,171.00		
National Research Council, for space	832.48		
		$5,671.05	
Joint Proceedings—			
Subscriptions	453.39		
National Research Council	1,250.00		
National Academy of Sciences	1,250.00		
		2,953.39	
General fund—			
Annual dues	660.00		
		660.00	
Thompson fund:			
Additional contribution by Mrs. Mary Clark Thompson		400.00	
Total income from investments		7,090.72	
Mortgage notes paid		9,000.00	
			25,775.16
Book transfers, distribution of consolidated			4,847.25
Total			44,279.02

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EXPENDITURES.

Book transfers, distribution of consolidated			$4,847.25
Cash expenditures:			
Investment of capital		$6,465.50	
Blue prints, and sign, building site		81.16	
			6,546.66
Payments from trust and other funds:			
Bache fund—			
W. Lindgren, grant	$300.00		
Gilbert N. Lewis, grant	500.00		
Frank P. Underhill and Lafayette B. Mendel, grant	200.00		
		1,000.00	
Draper fund—			
William Bowie, grant	200.00		
Gold medal	208.60		
		408.60	
Elliot fund, honorarium and gold medal		401.78	
Gibbs fund, R. L. Datta, grant		200.00	
Gould fund—			
The Astronomical Journal, grant	500.00		
William Bowie, grant	150.00		
		650.00	
Hartley fund, gold medal		69.70	
Marsh fund—			
Anna M. Tolhurst, grant	$100.00		
Carl O. Dunbar, grant	300.00		
W. J. Sinclair, grant	400.00		
		800.00	
Murray fund, medal		9.27	
Smith fund, S. A. Mitchell, grant		500.00	
Thompson fund—			
Proof medal by artist	$350.00		
Gold medal	415.57		
		765.57	
Watson fund, John A. Miller, grant		500.00	
			5,304.92
Academy Proceedings:			
Printing and distributing		1,763.24	
Expenses—			
Boston office		70.00	
Washington office		39.29	
Transferred from academy proceedings to joint proceedings, representing the contribution by the National Academy of Sciences		1,250.00	
			3,122.53
Joint Proceedings:			
Salary, managing editor		375.00	
Printing and distributing		366.11	
Expenses—			
Boston office		105.00	
Washington office		129.86	
			975.97

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General fund:		
Salary, assistant secretary	$450.00	
Home secretary's office	829.88	
Treasurer's office	158.75	
Memoirs, printing, etc	88.55	
Meeting, annual	610.90	
Election of members	63.11	
		$2,201.19
		22,998.52
Balance, June 30, 1921		21,280.50
Total		44,279.02

Accounts with individual funds Jan. 1 to June 30, 1921.

	General fund.		Agassiz fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1921:				
Cash	$1,128.80			
Invested				$50,000.00
Receipts:				
Interest on investments	1,386.80			
Annual taxes	660.00			
Total	3,175.10			50,000.00
Disbursements:				
General expenses	2,201.19			
Balance June 30, 1921:				
Cash	973.91			
Invested				50,000.00
Total	3,175.10			50,000.00

	Bache fund.		Billings fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1921:				
Cash	$1,597.96			
Invested		$59,000.00	$50.00	$5,000.00
Receipts:				
Interest on investments	1,636.43		139.70	
Transfer from income to capital		1,000.00		
Total	3,234.39	60,000.00	189.70	5,000.00
Disbursements:				
Grants	1,000.00			
Transfer to Proceedings			139.70	
Transfer from income to capital	1,000.00			
Balance June 30, 1921:				
Cash	1,234.39			
Invested		60,000.00	50.00	5,000.00
Total	3,234.39	60,000.00	189.70	5,000.00

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Accounts with individual funds Jan. 1 to June 30, 1921—Continued.

	Building site.		Comstock fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1921:				
Cash	$348.61		$1,287.77	$141.02
Invested	2,240.00		500.00	12,265.00
Receipts, interest on investments	312.50		313.91	
Total	2,901.11		2,101.68	12,406.02
Disbursements, plats, blue prints, and sign	81.16			
Balance June 30, 1921:				
Cash	479.95		1,601.68	141.02
Invested	2,240.00		500.00	12,265.00
Total	2,901.11		2,101.68	12,406.02

	Consolidated fund.		Draper fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1921:				
Cash	$1,441.00	$0.75	$762.09	
Invested		174,744.75	917.50	$10,000.00
Receipts:				
Interest on investments	4,716.50		302.26	
Cash transfer (Bache)		1,000.00		
Total	6,157.50	175,745.50	1,981.76	10,000.00
Disbursements:				
Distribution of consolidated	4,847.25			
Grants and medals			408.60	
Balance June 30, 1921:				
Cash	1,310.25	1,517.75	655.66	
Invested		174,227.75	917.50	10,000.00
Total	6,157.50	175,745.50	1,981.76	10,000.00

	Elliot fund.		Gibbs fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1921:				
Cash	$847.89		$72.15	
Invested	300.00	$8,000.00	500.00	$5,545.50
Receipts, interest on investments	228.85		164.74	
Total	1,376.74	8,000.00	736.89	5,545.50
Disbursements:				
Honorarium and gold medal	401.78			
Grant			200.00	
Balance June 30, 1921:				
Cash	674.96		36.89	
Invested	300.00	8,000.00	500.00	5,545.50
Total	1,376.74	8,000.00	736.89	5,545.50

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Accounts with individual funds Jan. 1 to June 30, 1921—Continued.

	Gould fund.		Hale lectureship.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1921:				
Cash	$837.16	$7.50	$40.59	.....
Invested	7,010.00	19,992.50	200.00	.....
Receipts:				
Interest on investments	710.56	.....	4.24	.....
Total	8,557.72	20,000.00	244.83	.....
Disbursements:				
Grants	650.00	.....	.....	.....
Balance June 30, 1921:				
Cash	897.72	2,007.50	44.83	.....
Invested	7,010.00	17,992.50	200.00	.....
Total	8,557.72	20,000.00	244.83	.....

	Hartley fund.		Marsh fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1921:				
Cash	$166.94	.....	$1,457.38	.....
Invested	.....	$1,200.00	150.00	$20,000.00
Receipts, interest on investments	33.44	.....	557.71	.....
Total	200.38	1,200.00	2,165.09	20,000.00
Disbursements:				
Medal	69.70	.....	.....	.....
Grants	.....	.....	800.00	.....
Balance June 30, 1921:				
Cash	130.68	.....	1,215.09	.....
Invested	.....	1,200.00	150.00	20,000.00
Total	200.38	1,200.00	2,165.09	20,000.00

	Murray fund.		Emergency fund, Proceedings.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1921:				
Cash	$611.76	.....	$477.54	.....
Invested	400.00	$6,000.00	.....	.....
Receipts:				
Interest on investments	174.74	.....	.....	.....
Loan repaid by Academy Proceedings	.....	.....	1,562.46	.....
Total	1,186.50	6,000.00	2,040.00	.....
Disbursements:				
Medal	9.27	.....	.....	.....
Balance June 30, 1921:				
Cash	777.23	.....	2,040.00	.....
Invested	400.00	6,000.00	.....	.....
Total	1,186.50	6,000.00	2,040.00	.....

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Accounts with individual funds Jan. 1 to June 30, 1921—Continued.

	Academy Proceedings.		Joint Proceedings.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1921:				
Cash				
Receipts:				
Subscriptions	$167.00		$453.39	
Annual dues	1,035.00			
Reprints and separates	465.57			
Transfer from Billings fund	139.70			
Special contributions secured by Dr. Chas. D. Walcott	3,171.00			
Payment by National Research Council for space	832.48			
Contribution by National Research Council			1,250.00	
Transferred from Academy Proceedings to Joint Proceedings representing contribution by National Academy of Sciences			1,250.00	
Total	5,810.75		2,953.39	
Disbursements:				
Salary of managing editor			375.00	
Printing and distributing	1,763.24		366.11	
Expenses Boston office	70.00		105.00	
Expenses Washington office	39.29		129.86	
Loan repaid to emergency fund, Proceedings	1,562.46			
Transferred from Academy Proceedings to Joint Proceedings representing contributions by National Academy of Sciences	1,250.00			
Balance June 30, 1921, cash	1,125.76		1,977.42	
Total	5,810.75		2,953.39	

	Smith fund.		Thompson fund.	
	Income.	Capital.	Income.	Capital.
Balance Jan. 1, 1921:				
Cash	$1,413.76		$173.93	
Invested	2,560.00	$10,000.00		$10,000.00
Receipts:				
Interest on investments	357.23		212.50	
Additional contribution by Mrs. Mary Clark Thompson			400.00	
Total	4,330.99	10,000.00	786.43	10,000.00
Disbursements:				
Grant	500.00			
Proof medal by artist			350.00	
Gold medal			415.57	
Balance June 30, 1921:				
Cash	1,288.49		20.86	
Invested	2,542.50	10,000.00		10,000.00
Total	4,330.99	10,000.00	786.43	10,000.00

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Accounts with individual funds Jan. 1 to June 30, 1921—Continued.

	Watson fund.	
	Income.	Capital.
Balance Jan. 1, 1921:		
Cash	$918.85	$23.75
Invested	1,780.00	24,976.25
Receipts:		
Interest on investments	685.86	.....
Total	3,384.71	25,000.00
Disbursements:		
Grants	500.00	.....
Balance June 30, 1921:		
Cash	1,104.71	23.75
Invested	1,780.00	24,976.25
Total	3,384.71	25,000.00

NATIONAL RESEARCH COUNCIL.

During the six months beginning January 1, 1921, the activities of the National Research Council were supported by funds derived from various sources. The following list gives the main sources of these funds:

(1) For general maintenance expenses of the National Research Council the sum of $85,000 was received from the Carnegie Corporation of New York.

(2) From the Rockefeller Foundation the following amounts were received and disbursed: For the division of medical sciences the sum of $4.98 was received and the sum of $504.98 was disbursed. For the division of physical sciences the sum of $8,320.83 was received and the sum of $4,367.35 was disbursed. For national research fellowships the sum of $27,114.72 was received and the sum of $22,109.40 was disbursed.

(3) From the General Education Board contribution was made as follows: For the mental rating of school children, nothing was received, but $98.38 was disbursed, thus closing the account. For special work carried on by the division of educational relations, the sum of $2,500 was received and the sum of $4,945.67 was disbursed.

(4) Other contributions included:

The sum of $1,583.33 from the Southern Pine Association (part payment on pledge of $10,000) for the committee on forestry.

The sum of $500 from Julius Rosenwald toward the support of a fellowship.

From various sources: For food and nutrition committee, $1,200; for the trustees for the publication of physical and chemical con-

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stants, $3,120; for international auxiliary language, $1,025; for national intelligence tests, $500; for expenses of exhibits, Chemical Warfare Service, $9,056.56.

Receipts and disbursements of the National Research Council, January 1, 1921, to June 30, 1921.

RECEIPTS.

Jan. 1, 1921. Cash in bank	$28,305.26	
Investments owned:		
Unappropriated fund, special	3,100.00	
		$31,405.26
Appropriations:		
Rockefeller Foundation—		
Medical sciences (R. F. 2369)	4.98	
Physical sciences (R. F. 2518)	8,320.83	
National Research fellowships (R. F. 2517)	27,114.72	
General Education Board—		
Division of educational relations	2,500.00	
Food and nutrition committee	1,200.00	
Trustees for the publication of physical and chemical constants	8,120.00	
Sale of United States Treasury 5¼ per cent certificates	3,500.00	
Interest on United States Treasury 5¼ per cent certificates	101.18	
Carnegie Corporation of New York (direct)	85,000.00	
Miscellaneous receipts	26,245.83	
Reimbursements	1,166.23	
Committee on forestry	1,583.33	
International auxiliary language	1,025.00	
Rosenwald fellowship	500.00	
Unappropriated fund, special (interest on investments)	79.24	
Sale of United States Treasury certificates	50,208.74	
Interest received on United States Treasury certificates	1,686.56	
Expenses of exhibit, chemical warfare service	9,056.56	
National intelligence tests	500.00	
		222,913.20
		254,318.46

DISBURSEMENTS.

Divisions:	
I. Federal relations, general maintenance, 1921	30.50
II. Foreign relations—	
General maintenance, 1921	222.71
William Ellery Hale fund, 1921	675.83

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Divisions—Continued.	
III. States relations—	
General maintenance—	
1920	$174.94
1921	326.49
IV. Educational relations—	
General maintenance, 1921	258.68
General education board	4,945.67
V. Research extension—	
General maintenance, 1921	1,182.41
Expenses of exhibit, chemical warfare service, 1921	8,837.78
VI. Research information service—	
General maintenance—	
1920	130.06
1921	1,049.79
Contingent expenses, 1921	387.08
Equipment, 1921	668.43
National Academy Proceedings and subscriptions, 1921	2,082.48
General education board, mental rating of school children	98.38
Personnel research federation	311.52
VII. Division of physical sciences—	
General maintenance, 1921	1,040.35
Traveling expenses, etc. (R. F. 2518)	4,367.35
Transactions of the American Mathematical Society, 1921	600.00
VIII. Engineering—	
General maintenance, 1921	1,128.16
Office expenses, 1921	390.27
Projects, 1921	486.83
Industrial personnel conference, 1921	213.52
IX. Chemistry and chemical technology—	
General maintenance, 1921	814.15
International auxiliary language	1,109.00
Research fellowships (R. F. 2517)	22,109.40
Trustees for the publication of physical and chemical constants	945.50
Purchase of United States Treasury certificates	6,500.00
Projects, 1921	250.00
X. Geology and geography—	
General maintenance, 1921	1,061.64
Bulletin of the Seismological Society	300.00
Projects, 1921	-------
XI. Medical sciences—	
General maintenance, 1921	1,671.47
Rockefeller Foundation (R. F. 2369)	504.98
Projects, 1921	532.12

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Divisions—Continued.		
XII. Biology and agriculture—		
General maintenance, 1921	$1,203.15	
Botanical abstracts, 1921	677.96	
Committee on forestry	765.05	
Food and nutrition committee	525.73	
Food products investigation fund	250.00	
Physiological salt requirements committee, 1921	178.81	
Rosenwald fellowship	1,166.66	
European distribution of American biological journals, 1921	1,000.00	
Promotion of Sigma Xi research fellowships	200.00	
XIII. Anthropology and psychology—		
General maintenance, 1921	1,788.65	
American archæological project, 1921	82.27	
National intelligence tests, 1921	300.00	
Function of the semicircular canals, 1921	614.30	
Executive board, general maintenance—		
1920	———	
1921	1,955.32	
American Geophysical Union, 1921	574.37	
Publicity committee, general maintenance, 1921	1,039.41	
Publications, 1921	2,977.68	
Committee on Concilium Bibliographicum, 1921	600.00	
Committee on conservation, 1921	143.99	
Contingent expenses, 1921	406.00	
Electricity, 1921	410.30	
Expenses and supplies, 1921	2,340.84	
Fuel, 1921	52.81	
New equipment, general, 1921	584.45	
Rent—		
1921	3,125.00	
1922	625.00	
Salaries, 1921	60,365.40	
Telephone and telegraph, 1921	755.86	
Purchase of United States Treasury 5¾ per cent certificates	25,208.74	
Purchase of United States Treasury 5½ per cent certificates	70,000.00	
		$245,320.14
June 30, 1921:		
Cash in bank	5,898.32	
Investments owned:		
Unappropriated fund, special	3,100.00	
		8,998.32
		254,318.46

F. L. RANSOME, *Treasurer.*

AUGUST 1, 1921.

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REPORT OF THE AUDITING COMMITTEE.

WASHINGTON, *D. C., July 30, 1921.*

We have employed the Capital Audit Co. to scrutinize and report on the treasurer's books. We accepted the certificate, dated July 6, 1921, of the American Security & Trust Co. regarding notes owned by the academy and deposited for collection; we have examined the securities owned by the academy and papers contained in the box of the National Academy of Sciences at the vault of the American Security & Trust Co. We find them to correspond to the list checked by the auditing committee on January 15, 1921, except as modified by transactions between January 1, 1921, and June 30, 1921, reported by the Capital Audit Co. We find that the coupons falling due during this period have been cut and accounted for, and those due July 1, 1921, have been deposited and are accounted for by appropriate entries in the pass book. We find that interest on loans has been accounted for. Correspondence between vouchers, pass books, and accounts of the treasurer is certified by the Capital Audit Co. We find the net balance reported by the treasurer as of June 30, 1921, to accord with the statement of the American Security & Trust Co. and with the check book. This entire paragraph relates to the accounts of the National Academy of Sciences proper.

There is also a statement of the accounts of the National Research Council, whose funds are deposited in two separate accounts to the credit of the academy. These accounts have been included in the report of the Capital Audit Co. We have examined the long-term securities of the National Research Council deposited in the box of the American Security & Trust Co. and find them correct. We accepted the certificate, dated July 7, 1921, of the Riggs National Bank as to United States Treasury certificates of indebtedness owned by the National Research Council and held by the bank for collection. We find that the net balance reported by the treasurer as of June 30, 1921, agrees with the statements of the American Security & Trust Co. and of the Riggs National Bank for these accounts. Correspondence between vouchers, pass books, and accounts of the treasurer for the National Research Council is certified by the Capital Audit Co.

ARTHUR L. DAY,
L. O. HOWARD,
Auditing Committee.

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DECEASED MEMBERS.

HENRY ANDREWS BUMSTEAD.

[The Scientific Monthly, Vol. XII, No. 4, April, 1921, pp. 379–381, ill.]

Prof. Bumstead, of Yale University, whose admirable address on the history of physics is printed in the present issue of the Monthly, died suddenly on the night of December 31, at the age of 50 years. He had been in attendance on the meetings of the Physical Society at Chicago, of which he was a past president, and active in numerous conferences and committee meetings held during convocation week. The writer of this note was in conference with him concerning the organization of the Science Service, endowed by Mr. Scripps, until midnight on Thursday and again through Friday afternoon. His clear judgment and wise council were in constant evidence, and he appeared to be in the best of health. On Friday evening he took the train for Washington; on the following morning he was found dead in his berth.

Bumstead was the chairman of the National Research Council for the present year, succeeding Dr. James Rowland Angell, who now assumes the presidency of Yale University, where Bumstead was professor of physics and director of the Sloane Physical Laboratory. He remarked at Chicago that he was ready to devote this year to the odd jobs of science, but that he planned at the end of it to return to the research work interrupted by the war. This work was concerned with radioactivity and the Röntgen rays. He was especially interested in photoelectric effects, delta rays, and the theory of electrons.

In Nature for February 5 will be found an appreciation by Sir J. J. Thomson, with whom Bumstead worked at Cambridge and with whom, as president of the Royal Society, he was associated during the war period. Prof. R. A. Millikan, with whom Bumstead had been closely associated both as a physicist and in the conduct of the National Research Council, writes in an article printed in the issue of Science for January 25:

> When in 1917 the important and difficult post of scientific attaché in London was created, Bumstead was the only man considered, for no scientist in this country had his tact, his judgment, his knowledge of England, and his ability to assist in bringing about what was then, and what is now, the most important need of the modern world, namely, the cooperation and mutual understanding of the two great branches of the Anglo-Saxon race. Bumstead's

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success in London was extraordinary. The British liked and trusted him. Admiral Sims and our own War Department placed large responsibilities upon him, and his office became the center of a very active and very important service. Young American officers who went abroad on scientific missions found him the center of their contacts and the prime source of their usefulness. They all became his devoted admirers. Not one or two, but a dozen or more, of both British and American officers who came to Washington during the war, told me that they owed their success in their work in England and the Continent primarily to Bumstead, and counted it the most valuable part of their experience that they had had an opportunity to become acquainted with him. One of these officers described him as the most influential American in England.

He had a brilliant analytical mind, profound scholarship, exceptional critical capacity, excellent judgment, an extraordinary winsome personality, the finest culture, and a great heart. His personal scientific contributions were important, though they had been much interfered with by his none too rugged health. His effect upon American physics, however, was not limited to his own scientific papers, but he exerted a powerful influence upon his pupils and upon his fellow physicists. It is not merely American science, however, which can ill afford to lose him 20 years before his time. American life in all its aspects is sadly in need of men of Bumstead's type. The cause of sanity, of culture, of Anglo-Saxon solidarity, of scholarship, of science, of world civilization, all suffer irreparably through his death.

EDWARD BENNETT ROSA.

[Science, new series, Vol. LIII, No. 1382, June 24, 1921, p. 569.]

By S. W. Stratton.

Dr. Edward B. Rosa, chief physicist of the Bureau of Standards at Washington, died suddenly at his desk on Tuesday afternoon, May 17, 1921. Dr. Rosa was at the time the chief of Division I of the Bureau of Standards, the functions of which include research, standardization, and testing in the fields of electricity, magnetism, photometry, radio communication, radium, X-ray, and public utilities. Dr. Rosa was appointed physicist in the bureau in 1901. In 1910 he was given the grade of chief physicist. Dr. Rosa's painstaking accuracy in scientific research is well known among specialists in the fields in which he worked. His investigations have been published in 36 scientific publications of the bureau and 4 technologic papers, not to speak of a large number of special reports, circulars, and articles in technical journals.

Among the researches of unusual interest may be mentioned the precise determination of the value of the coulomb, the value of the ampere, and of the ratio between the electrostatic and the electromagnetic units of electricity. His other laboratory researches include a wide range of problems chiefly connected with the improvement of the standards and methods used in precise electrical measurements.

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Perhaps one of the most striking examples of Dr. Rosa's thoroughness and success in securing the cooperation of the technical groups interested may be found in the development and publication of the national electrical safety code, the revised form of which has just recently appeared as a "handbook" issued by the Bureau of Standards.

In his work as administrator he successfully organized the work of electrical testing, photometry, radium testing, and research and standardization work involved in radio communication. Dr. Rosa showed a deep interest in all phases of the bureau's development, and will be remembered with profound respect and admiration by his colleagues. His work will endure as a permanent foundation for the branches of physics and electrical engineering to which he devoted so many useful years of his life.

DEPARTMENT OF COMMERCE,
BUREAU OF STANDARDS.

[Nature, London, No. 2693, vol. 107, June 9, 1921, pp. 465–466.]

The death, on May 17, of Prof. Edward Bennett Rosa, of the Bureau of Standards, at Washington, at the age of 60 years, is a serious blow to electrical science. Born in 1861, Prof. Rosa gained distinction as a student in the Johns Hopkins University under Rowland, and after some experience in professional work in the Wesleyan University, where his early undergraduate days had been passed, was in 1901 appointed to the staff of the Bureau of Standards as a physicist. There his main work was done. In 1910 he became chief physicist, and as head of the electrical department was responsible for many of the valuable researches which have been carried out at the bureau.

Among the earliest of these was his determination, in collaboration with Dr. Dorsey, of "v," the ratio of the electric units, and most of them turn on questions relating to the measurement of the fundamental units, the ohm, the ampere, and the volt. He combined in a marked degree the insight required to design and carry through to a successful result a difficult experiment and the mathematical skill needed to develop to a high degree of accuracy the theory on which the experiment is based.

Prof. Rosa's papers on the calculation of coefficients of self and mutual induction, and on the theory of the instruments employed in absolute measurements, will always be standard, while his own experimental determination of some of the fundamental quantities are among the best which have been made. He realized the need for accuracy and exactness in the processes of measurement, whether applied to scientific work or to industry, and he organized the electrical section of the bureau in a manner which fitted it to respond to the requirements both of scientific and industrial research. The list of his papers covers a wide range, and in all of them he added to our knowledge in a substantial manner.

Prof. Rosa visited England in 1908, acting, along with Dr. Stratton and Prof. Carhart, as one of the American representatives to the International Electrical Conference, held in London under the presidency of the late Lord Rayleigh. At that conference a formal distinction was drawn between the absolute and the international units of measurement, between the ohm (10° abso-

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lute C. G. S. units) and the international ohm—the resistance at 0° C. of a uniform column of mercury weighing 14.521 grams, and 106.300 centimeters in length, or the ampere (10^{-1} absolute C. G. S. units) and the international ampere—the current which under certain carefully defined conditions deposits from a solution of nitrate of silver a mass of 1.11800 milligrams of silver per second.

Prof. Rosa would probably have preferred to retain as standards for legal purposes the absolute magnitudes 10^9 C. G. S. units for resistance and 10^{-1} C. G. S. units for current, but he accepted the views of the majority of the conference, and at a later date lent his valuable assistance in defining accurately the conditions necessary for the realization of the international ohm, ampere, and volt. As the outcome of the work of the conference, a committee, known as Lord Rayleigh's committee, was appointed to define these conditions, and representatives of England, France, and Germany met at Washington and carried out a series of experiments, the results of which have determined the practice of all national standardizing laboratories. Of the committee engaged in this work, Prof. Rosa was the active head, and its successful issue was due in no small degree to his skill in overcoming the technical difficulties of the task and to his tact in dealing with the varied views of those engaged in the research.

The volume giving an account of these experiments, published by the Bureau of Standards in 1912, will form a fitting memorial of one who for the last 20 years devoted himself unweariedly to the advancement of electrical science. During the war he directed the development of a number of instruments of great use to the American forces in France. Among these may be mentioned a sound-ranging device and much radio apparatus suitable especially for aircraft. He was greatly instrumental in establishing the splendid radio laboratory at the bureau. Throughout his life he was keenly interested in the prevention of industrial accidents and in the provision of safety standards for the guidance of public authorities. The National Electrical Safety Code at present in use in the United States owes much to him. His last work, now in the press, was an analysis of the expenditure of the Government departments, which contains a number of statistics of great importance and interest.

Prof. Rosa was married in 1894, and Mrs. Rosa survives him. She has the deep sympathy of all those on this side of the Atlantic who knew her husband and appreciated his work.

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APPENDIXES.

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APPENDIX A.

CONSTITUTION OF THE NATIONAL ACADEMY.

[As amended and adopted Apr. 17, 1872, and further amended Apr. 20, 1875; Apr. 21, 1881; Apr. 19, 1882; Apr. 18, 1888; Apr. 19, 1888; Apr. 18, 1895; Apr. 20, 1899; Apr. 17, 1902; Apr. 18, 1906; Nov. 20, 1906; Apr. 17, 1907; Nov. 20, 1907; Apr. 20, 1911; Apr. 16, 1912; Apr. 21, 1915.]

PREAMBLE.

Empowered by the act of incorporation enacted by Congress, and approved by the President of the United States on the 3d day of March, A. D. 1863, and in conformity with amendments to said act approved July 14, 1870, June 20, 1884, and May 27, 1914, the National Academy of Sciences adopts the following amended constitution and rules:

ARTICLE I.—OF MEMBERS.

SECTION 1. The Academy shall consist of members, honorary members, and foreign associates. Members must be citizens of the United States.

SEC. 2. Members who, from age or inability to attend the meetings of the Academy, wish to resign the duties of active membership, may, at their own request, be transferred to the roll of honorary members by a vote of the Academy.

SEC. 3. The Academy may elect 50 foreign associates.

SEC. 4. Honorary members and foreign associates shall have the privilege of attending the meetings and of reading and communicating papers to the Academy, but shall take no part in its business, shall not be subject to its assessments, and shall be entitled to a copy of the publications of the Academy.

ARTICLE II.—OF THE OFFICERS.

SECTION 1. The officers of the Academy shall be a president, a vice president, a foreign secretary, a home secretary, and a treasurer, all of whom shall be elected for a term of four years, by a majority of votes present, at the first stated meeting after the expiration of the current terms, provided that existing officers retain their places until their successors are elected. In case of a vacancy, the election for four years shall be held in the same manner at the meeting when such vacancy occurs, or at the next stated meeting thereafter, as the Academy may direct. A vacancy in the office of treasurer or home secretary may, however, be filled by appointment of the president of the Academy until the next stated meeting of the Academy.

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SEC. 2. The officers of the Academy, together with six members to be elected by the Academy, shall constitute a council for the transaction of such business as may be assigned to them by the constitution or the Academy.

SEC. 3. The president of the Academy, or, in case of his absence or inability to act, the vice president, shall preside at the meetings of the Academy and of the council; shall name all committees except such as are otherwise especially provided for; shall refer investigations required by the Government of the United States to members especially conversant with the subjects and report thereon to the Academy at its meeting next ensuing; and, with the council, shall direct the general business of the Academy.

It shall be competent for the president, in special cases, to call in the aid, upon committees, of experts or men of special attainments not members of the Academy.

The president shall be, ex officio, a member of all committees empowered to consider questions referred to the Academy by the Government of the United States.

SEC. 4. The foreign and home secretaries shall conduct the correspondence proper to their respective departments, advising with the president and council in cases of doubt, and reporting their action to the Academy at one of the stated meetings in each year.

It shall be the duty of the home secretary to give notice to the members of the place and time of all meetings, of all nominations for membership, and of all proposed amendments to the constitution.

It shall be the duty of the home secretary to keep the minutes of each business and scientific session, and after approval to enter these upon the permanent records of the Academy.

SEC. 5. The treasurer shall attend to all receipts and disbursements of the Academy, giving such bond and furnishing such vouchers as the council may require. He shall collect all dues, assessments, and subscriptions, and keep a set of books showing a full account of receipts and disbursements and the condition of all funds of the Academy. He shall be the custodian of the corporate seal of the Academy.

ARTICLE III.—OF THE MEETINGS.

SECTION 1. The Academy shall hold one stated meeting, called the annual meeting, in April of each year in the city of Washington, and another stated meeting, called the autumn meeting, at a place to be determined by the council. The council shall also have power to fix the date of each meeting.

Special business meetings of the Academy may be called, by order of eight members of the council, at such place and time as may be designated in the call.

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Special scientific meetings of the Academy may be held at times and places to be designated by a majority of the council.

SEC. 2. The names of the members present at each session of a meeting shall be recorded in the minutes, and 20 members shall constitute a quorum for the transaction of business.

SEC. 3. Scientific sessions of the Academy, unless otherwise ordered by a majority of the members present, shall be open to the public; sessions for the transaction of business shall be closed.

SEC. 4. Stated meetings of the council shall be held during the stated or special meetings of the Academy, and four members shall constitute a quorum for the transaction of business. Special meetings of the council may be convened at the call of the president and two members of the council, or of four members of the council.

SEC. 5. No member whose dues are in arrears shall vote at any business meeting of the Academy.

ARTICLE IV.—OF ELECTIONS AND REGULATIONS.

SECTION 1. All elections of officers and members shall be by ballot, and each election shall be held separately.

SEC. 2. The time for holding an election of officers shall be fixed by the Academy at least one day before the election is held.

SEC. 3. The election of the six members of the council shall be as follows:

At the annual meeting in April, 1907, six members of the council to be elected, of whom two shall serve for three years, two for two years, and two for one year, their respective terms to be determined by lot. Each year thereafter the terms of two members shall expire, and their successors, to serve for three years, shall be elected at the annual meeting in each year.

SEC. 4. The Academy shall be divided by the council into sections representing the principal branches of scientific research. Each section shall elect its own chairman, who shall serve for three years. The chairman shall be responsible to the Academy for the work of his section.

Nominations to membership in the Academy shall be made in writing and approved by a majority of the members of the section on the branch of research in which the person nominated is eminent, or by a majority of the council in case there is no section on the subject. The nomination shall be sent to the home secretary by the chairman of the section before January 1 of the year in which the election is to be held, and each nomination shall be accompanied by a list of the principal contributions of the nominee to science. This list shall be printed by the home secretary for distribution among the members of the Academy.

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SEC. 5. Election of members shall be held at the annual meeting in Washington in the following manner: There shall be two ballots—a preference ballot, which may be prepared either before or at the annual meeting, and must be transmitted to the home secretary, and a final ballot, to be taken at the meeting.

Preference ballot.—Each member may inscribe on a ballot not more that 15 names of nominees selected from the submitted list. A list of the nominees shall then be prepared, on which the names shall be entered in the order of the number of votes received by each. In case two or more nominees have the same number of votes on this preference list, the order in which they shall be placed on the list shall be determined by a majority vote of members present.

Final ballot.—A vote shall first be taken on the nominee who appears first on the preference list, and he shall be declared elected if he receive two-thirds of the votes cast and not less than 25 votes in all. A vote shall then be taken in similar manner on the nominee standing second on the preference list, and so on until all the nominees on the preference list shall have been acted on, or until 15 nominees shall have been elected, or until the total membership of the Academy shall have reached 250.

Not more than 15 members shall be elected at one annual meeting.

Before and during elections a discussion of the merits of nominees will be in order.

SEC. 6. Every member-elect shall accept his membership, personally or in writing, before the close of the next stated meeting after the date of his election. Otherwise, on proof that the secretary has formally notified him of his election, his name shall not be entered on the roll of members.

SEC. 7. Foreign associates may be nominated by the council and may be elected at the annual meeting by a two-thirds vote of the members present.

SEC. 8. A diploma, with the corporate seal of the Academy and the signatures of the officers, shall be sent by the appropriate secretary to each member on his acceptance of membership, and to foreign associates on their election.

SEC. 9. Resignations shall be addressed to the president and acted on by the Academy.

SEC. 10. Whenever a member has not paid his dues for four successive years, the treasurer shall report the fact to the council, which may report the case to the Academy with the recommendation that the person thus in arrears be declared to have forefeited his membership. If this recommendation be approved by two-thirds of the members present, the said person shall no longer be a member of the Academy and his name shall be dropped from the roll.

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ARTICLE V.—SCIENTIFIC COMMUNICATIONS, PUBLICATIONS, AND REPORTS.

SECTION 1. Communications on scientific subjects shall be read at scientific sessions of the Academy, and papers by any member may be read by the author or by any other member, notice of the same having been previously given to the secretary.

SEC. 2. Any member of the Academy may read a paper from a person who is not a member, and shall not be considered responsible for the facts or opinions expressed by the author, but shall be held responsible for the propriety of the paper.

Persons who are not members may read papers on invitation of the council or of the committee of arrangements.

SEC. 3. The Academy may provide for the publication, under the direction of the council, of proceedings, scientific memoirs, biographical memoirs, and reports.

The proceedings shall include the transactions of the Academy, brief original announcements of the results of scientific investigations made by members of the Academy or others, together with short original articles giving a comprehensive survey of the more important scientific researches currently made by American investigators, and other matters of general scientific interest.

The scientific memoirs shall provide opportunity for the publication of longer and more detailed scientific investigations.

The biographical memoirs shall contain an appropriate record of the life and work of deceased members of the Academy.

An annual report shall be presented to Congress by the president and shall contain the annual reports of the treasurer and the auditing committee, a suitable summary of the reports of the committees in charge of trust funds, and a record of the activities of the Academy for the calendar year immediately preceding, and other appropriate matter. This report shall be presented to Congress by the president after authorization by the council. It shall also be presented to the Academy at the annual meeting next following.

The treasurer shall prepare a full report of the financial affairs of the Academy at the end of the fiscal year. This report shall be submitted to the council for approval and afterwards presented to the Academy at the next stated meeting. He shall also prepare a supplementary financial statement to December 31 of the ensuing fiscal year for presentation at the annual meeting.

SEC. 4. Propositions for investigations or reports by the Academy shall be submitted to the council for approval, except those requested by the Government of the United States, which shall be acted on by the president, who will in such cases report their results to the Gov-

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ernment as soon as obtained and to the Academy at its next following stated meeting.

SEC. 5. The advice of the Academy shall be at all times at the disposition of the Government upon any matter of science or art within its scope.

ARTICLE VI.—OF THE PROPERTY OF THE ACADEMY.

SECTION 1. All investments and reinvestments of either principal or accumulations of income of the trust and other funds of the Academy shall be made by the treasurer, with the approval of the finance committee, in the corporate name of the Academy, in the manner and in the securities designated or specified in the instruments creating the several funds, or, in the absence of such designation or specification, in bonds of the United States or of the several States, or in bonds or notes secured by first mortgages on real estate, in investments legal for savings banks under the laws of Massachusetts or New York, or in other bonds recommended to the treasurer by the fiscal advisers of the Academy.

The treasurer may invest the captial of all trust funds of the Academy which are not required by the instruments creating such funds to be kept separate and distinct, in a consolidated fund, and shall apportion the income received from such consolidated fund among the various funds composing the same in the proportion that each of said funds shall bear to the total amount of funds so invested; provided, however, that the treasurer shall at all times keep accurate accounts showing the amount of each trust fund, the proportion of the income from the consolidated fund to which it is entitled, and the expenses and disbursements properly chargeable to such fund.

SEC. 2. The council shall at its annual meeting in each year designate one bank or trust company in Washington, D. C., and one in New York City to act, when requested by the treasurer, as the fiscal advisers of the Academy.

SEC. 3. The treasurer shall have authority, with the approval of the finance committee, to sell, transfer, convey, and deliver in the corporate name and for the benefit of the Academy any stocks, bonds, or other securities standing in the corporate name.

SEC. 4. No contract shall be binding upon the Academy which has not been first approved by the council.

SEC. 5. The assessments required for the support of the Academy shall be fixed by the Academy on the recommendation of the council and shall be payable within the calendar year for which they are assessed.

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ARTICLE VII.—OF TRUST FUNDS AND THEIR ADMINISTRATION.

SECTION 1. Devises, bequests, donations, or gifts having for their object the promotion of science or the welfare of the Academy may be accepted by the council for the Academy. Before the acceptance of any such trust the council shall consider the object of the trust and all conditions or specifications attaching thereto. The council shall make a report of its action to the Academy.

SEC. 2. Medals and prizes may be established in accordance with the provisions of trusts or by action of the Academy.

SEC. 3. Unless otherwise provided by the deed of gift, the income of each trust fund shall be applied to the objects of that trust by the action of the Academy on the recommendation of a standing committee on that fund.

ARTICLE VIII.—OF ADDITIONS AND AMENDMENTS.

Additions and amendments to the constitution shall be made only at a stated meeting of the Academy. Notice of a proposition for such a change must be submitted to the council, which may amend the proposition, and shall repart thereon to the Academy. Its report shall be considered by the Academy in committee of the whole for amendment.

The proposition as amended, if adopted in committee of the whole, shall be voted on at the next stated meeting, and if it receives two-thirds of the votes cast it shall be declared adopted.

Absent members may send their votes on pending changes in the constitution to the home secretary in writing, and such votes shall be counted as if the members were present.

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APPENDIX B.

RULES.

[In accordance with a resolution of the Academy, taken at its meeting on Apr. 21, 1915, the rules are arranged in groups and each group is numbered to correspond with the article of the constitution to which it relates.]

I.

1. The holders of the medal for eminence in the application of science to the public welfare shall be notified, like members, of the meetings of the Academy, and invited to participate in its scientific sessions.

II.

1. The proper secretary shall acknowledge all donations made to the Academy, and shall at once report them to the council for its consideration.

2. The home secretary shall be the custodian of all books, apparatus, archives, and collections not explicitly assigned to other care.

3. The home secretary shall keep a record of all grants of money or awards of prizes or medals made from trust funds of the Academy. The assistant secretary, who may be a nonmember of the Academy, shall receive a salary to be fixed by the council. The record for each grant of money shall include the following items: Name of fund, date and number of the grant, name and address of recipient, amount of grant and date or dates of payment, purpose of grant, record of report of progress, and resulting publications.

4. The treasurer shall keep the home secretary informed of all warrants received from directors of trust funds not controlled by the Academy and of the date or dates of payment of all warrants.

5. The treasurer is authorized to defray, when approved by the president, all the proper expenses of committees appointed to make scientific investigations at the request of departments of the Government, and in each case to look to the department requesting the investigation for reimbursement to the Academy.

6. The treasurer is authorized to act as the treasurer ex officio of the National Research Council.

7. The treasurer shall have the assistance of a salaried and bonded officer, the bursar, who shall be chosen by the finance committee and be directly responsible to the treasurer.

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III.

1. The annual meeting of the Academy shall begin on the fourth Monday of April. At the business sessions of the Academy the order of procedure shall be as follows:

(1) Chair taken by the president, or, in his absence, by the vice president.
(2) Roll of members called by home secretary (first session of the meeting only).
(3) Minutes of the preceding session read and approved.
(4) Stated business.
(5) Reports of president, secretaries, treasurer, and committees.
(6) Business from council.
(7) Other business.

2. The rules of order of the Academy shall be those of the Senate of the United States, unless otherwise provided by the constitution or rules of the Academy.

3. In the absence of any officer a member shall be chosen to perform his duties temporarily, by a plurality of viva voce votes, upon open nomination.

4. At each meeting the president shall announce the death of any members since the preceding meeting. As soon as practicable thereafter he shall designate a member to write—or to secure from some other source approved by the president—a biographical notice of each deceased member.

5. A local committee of five members, appointed for each meeting, and the home secretary shall together constitute the committee of arrangements, of which the home secretary shall be chairman.

It shall be the duty of the committee of arrangements to prepare the scientific program for the annual meeting, and for this purpose it shall be empowered to solicit papers from members or others. It shall also be empowered to ascertain the length of time required for reading papers to be presented at the scientific sessions of the Academy, and, when it appears advisable, to limit the time to be occupied in their presentation or discussion.

The committee of arrangements shall meet not less than two months previous to each meeting. It shall prepare the detailed program of each day, and in general shall have charge of all business and scientific arrangements for the meeting for which it is appointed.

6. No paper requiring more than 15 minutes for its presentation shall be accepted unless by invitation of the committee of arrangements.

No speaker shall occupy more than 30 minutes for presentation of papers during the scientific sessions of a single meeting of the Academy, except by invitation of the committee of arrangements.

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Time shall not be extended except by vote of the Academy and then not to exceed five minutes. The presiding officer shall warn speakers two minutes before the expiration of their time.

The discussion of individual papers shall be limited not to exceed five minutes and the total time for discussion by any one speaker for all scientific sessions in any one meeting shall not exceed 15 minutes, unless approved by the Academy.

No paper shall be entered upon the printed program of scientific sessions unless the title is in the hands of the committee of arrangements at least two weeks in advance of the meeting. In the event that titles are received later, they shall be placed in order of receipt at the end of the list and read, if there is time. Such supplementary titles shall be conspicuously posted.

IV.

1. The term of service of each chairman of a section shall be three years, to date from the closing session of the April meeting next following his election. Chairmen of sections shall be chosen by mail ballot, the member receiving the highest number of votes cast to be deemed elected. It shall be the duty of each retiring chairman to conduct the election of his successor and to report the result of the election to the home secretary before the April meeting at which his term of service expires. Should any section fail to elect a chairman before November 1, the president is empowered to appoint a temporary chairman to serve until the April meeting next following. No chairman shall be eligible for reelection for two consecutive terms.

2. The chairman of each section of the Academy shall submit to the members of his section, not later than November 1 of each year, a ballot containing the names of all those persons who received not less than two votes in the nominating ballot of the preceding year and of any other persons who were newly proposed for consideration at that time. Each member of the section shall be expected to return this ballot to the chairman within two weeks with his signature and with crosses placed against the names of those persons whom he is prepared to indorse for nomination. Each member may also write upon the ballot in a place provided for the purpose any new names which he desires to have included in the ballot to be submitted to the section in the following year. The vote resulting from this ballot shall be regarded as informal.

The chairman shall then submit to the members of his section a new ballot showing the results of the informal vote; and each member shall be expected to return this ballot to the chairman with his signature and with crosses placed against the names of those persons

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whom he will indorse for nomination. In order to secure an adequate number of nominations, the chairman, when necessary, shall obtain by personal solicitation a fuller vote of his section or shall submit to the section a supplementary formal ballot.

The chairman shall then certify to the home secretary, prior to January 1, the names of those persons who have been voted for on the formal ballots by a majority of the members of the section, and shall furnish him a list of the publications of these nominees, as required by the constitution.

3. Nominations for membership shall give the full name, residence, and the official positions successively held by the candidate, in addition to the list of his contributions to science required by the constitution.

4. Preference ballots for election of members shall be sealed in a blank envelope, which shall be inclosed in another bearing the name of the sender, and which shall be addressed to the home secretary. Such envelopes shall be opened only by the tellers. If in any case the tellers are unable to determine who cast a ballot, or if the latter contains more names than are to be voted for, the ballot shall be rejected, but minor defects in a ballot shall be disregarded when the intent of the voter is obvious.

5. All discussions of the claims and qualifications of nominees at meetings of the academy shall be held strictly confidential, and remarks and criticisms then made may be communicated to no person who was not a member of the Academy at the time of the discussion.

V.

1. The publication of the Proceedings shall be under the general charge of the council, which shall have final jurisdiction upon all questions of policy relating thereto.

The managing editor, who may be a nonmember of the Academy, shall receive a salary which shall be fixed by the council.

The National Academy of Sciences and the National Research Council shall cooperate in the publication of the Proceedings, beginning with Volume VII.

The management of the Proceedings shall be vested in an executive committee of three, consisting of the managing editor as chairman, for a term of one year, of a representative of the Academy, and a representative of the National Research Council, each to be appointed for a term of three years.

The editorial board shall consist of the home secretary and the foreign secretary of the Academy, the chairman and the permanent secretary of the National Research Council as ex officio members; and, in addition, of 10 representatives of the Academy and seven

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representatives of the Research Council, these numbers corresponding to the number of sections of the Academy and the number of divisions of science and technology of the Research Council.

Beginning with Volume VII the operation of the Proceedings shall be placed upon a budget basis, the size of the volume in any year to be determined by the conditions of the budget, the equal amounts contributed by each organization being determined by mutual agreement before the beginning of each calendar year.

The managing editor of the Proceedings shall be appointed by the council of the Academy and the executive board of the National Research Council upon the nomination of the editorial board.

2. Memoirs may be presented at any time to the home secretary, who shall report the date of their reception at the next session; but no memoir shall be published unless it has been read or presented by title before the Academy.

Before publication all biographical and scientific memoirs must be referred to the committee on publication, who may, if they deem best, refer any memoir to a special committee, appointed by the president, to determine whether the same should be published by the Academy.

3. Memoirs shall date, in the records of the Academy, from the date of their presentation to the Academy, and the order of their presentation shall be so arranged by the secretary that, so far as may be convenient, those upon kindred topics shall follow one another.

4. The annual report of the treasurer shall contain:

(1) A concise statement of the source, object, and amount of all trust funds of the academy.
(2) A condensed statement of receipts and expenditures.
(3) A statement of assets and liabilities.
(4) Accounts with individual funds.
(5) Such other matter as he considers appropriate.

5. The accounts of the treasurer shall, between July 1 and August 1 of each year, be audited under the direction of a committee of three members to be appointed by the president at the annual meeting of the Academy. It shall be the duty of the auditing committee to verify the record of receipts and disbursements maintained by the treasurer and the agreement of book and bank balances; to examine all securities in the custody of the treasurer and to compare the stated income of such securities with the receipts of record; to examine all vouchers covering disbursements for account of the Academy, including the National Research Council, and the authority therefor, and to compare them with the treasurer's record of expenditures; to examine and verify the account of the Academy with each trust fund. The auditing committee may employ an expert accountant to assist the committee in the examination of the books of the treasurer. The

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annual report of the treasurer shall be published with that of the president to Congress. The reports of the treasurer and auditing committee shall be presented to the Academy at the autumn meeting, and shall be published with that of the president to Congress. They shall be distributed to the members in printed form at the annual meeting.

VI.

1. All apparatus and other materials of permanent value purchased with money from any grant from a trust fund shall be the property of the Academy unless specific exception is made in the grant or by subsequent action of the council or the directors of the trust fund concerned. Receipts for all such property shall be signed by the grantee and shall be forwarded to the home secretary. All apparatus and unused material of value acquired in this way shall be delivered to the home secretary on completion of the investigation for which the grant was made, or at any time on demand of the council, and the home secretary shall give an appropriate release therefor.

2. The books, apparatus, archives, and other collections of the Academy shall be deposited in some safe place in the city of Washington. A list of the articles so deposited shall be kept by the home secretary, who is authorized to employ a clerk to take charge of them.

3. A stamp corresponding to the corporate seal of the Academy shall be kept by the secretaries, who shall be responsible for the due markings of all books and other objects to which it is applicable.

Labels or other proper marks of similar device shall be placed upon objects not admitting of the stamp.

4. The fiscal year of the Academy shall end on June 30 of each year.

5. The standing committee on finance shall consist of the president of the Academy ex officio, the treasurer ex officio as chairman, and five members to be appointed annually by the president, two of whom may be nonmembers of the Academy.

That a budget committee on the expenses of the National Academy and the National Research Council, to consist of the president of the Academy, the chairman of the National Research Council, and the treasurer of the National Academy of Sciences and the National Research Council, be appointed and the president of the Academy act as chairman.

VII.

1. Standing committees of the Academy on trust funds the income of which is applied to the promotion of research shall consist of three or five members. In order to secure rotation in office in such committees, when not in conflict with the provisions of the deeds of gift,

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the term of service on a committee of three members shall be three years; on a committee of five members the term shall be five years.

2. The annual reports of the committees on research funds shall, so far as the Academy has authority to determine their form, give a current number to each award, stating the name, position, and address of the recipient; the subject of research for which the award is made, and the sum awarded; and in later annual reports the status of the work accomplished under each award previously made shall be announced, until the research is completed, when announcement of its completion and, if published, the title and place of publication shall be stated, and the record of the award shall be reported as closed.

VIII.

1. Any rule of the Academy may be amended, suspended, or repealed on the written motion of any two members, signed by them, and presented at a stated meeting of the Academy, provided the same shall be approved by a majority of the members present.

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APPENDIX C.

ORGANIZATION OF THE ACADEMY, 1921.

	Expiration of term.
Walcott, Charles D., president	April, 1923
Michelson, A. A., vice president	April, 1923
Millikan, R. A., foreign secretary	April, 1922
Abbot, C. G., home secretary	April, 1923
Ransome, F. L., treasurer	April, 1923

ADDITIONAL MEMBERS OF COUNCIL.

1919–1922.

Carty, J. J. — Donaldson, H. H.

1920–1923.

Day, A. L. — Morgan, T. H.

1921–1924.

Pearl, Raymond. — Hale, George E.

SECTIONS.

1. MATHEMATICS.

Birkhoff, G. D.
Blichfeldt, H. F.
Bliss, G. A.
Bolza, Oskar
Dickson, L. E.
Kasner, Edward
Miller, George A.
Moore, E. H.
Osgood, W. F.
Story, W. E.
Van Vleck, E. B.
Veblen, Oswald
White, H. S. (chairman, 1922).
Wilczynski, E. J.

2. ASTRONOMY.

Abbot, C. G. (chairman, 1923).
Adams, W. S.
Aitken, R. G.
Barnard, E. E.
Campbell, W. W.
Comstock, G. C.
Curtis, H. D.
Elkin, W. L.
Frost, E. B.
Hale, G. E.
Leuschner, A. O.
Moulton, F. R.
Russell, H. N.
Schlesinger, Frank
Seares, F. H.
Slipher, V. M.
Stebbins, Joel

3. PHYSICS.

Ames, J. S.
Barus, Carl
Bell, A. G.
Bridgman, P. W.
Crew, Henry
Duane, William
Hall, E. H.
Hastings, C. S.
Hayford, J. F.
Lyman, Theodore
Mendenhall, C. E.
Mendenhall, C. E.
Merritt, Ernest
Michelson, A. A.
Miller, D. C.
Millikan, R. A.
Nichols, E. F.
Nichols, E. L.
Pierce, G. W.
Pupin, M. I.
Stratton, S. W.
Thomson, Elihu
Trowbridge, Augustus (chairman, 1923).
Trowbridge, John
Webster, A. G.
Wilson, Edwin B.
Wood, R. W.
Woodward, R. S.

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4. ENGINEERING.

Abbot, H. L.
Carty, J. J. (chairman, 1923).
Dunn, Gano
Durand, W. F.
Emmet, W. LeRoy
Freeman, J. R.
Howe, H. M.
Jewett, F. B.
Kennelly, A. E.
Ryan, H. J.
Squier, G. O.
Stillwell, L. B.
Taylor, D. W.

5. CHEMISTRY.

Bancroft, W. D.
Baxter, G. P.
Bogert, M. T.
Boltwood, B. B.
Chandler, C. F.
Clarke, F. W.
Franklin, E. C.
Gomberg, Moses
Gooch, F. A.
Harkins, W. D.
Hillebrand, W. F.
Jackson, C. L.
Johnson, T. B.
Kohler, E. P.
Langmuir, Irving
Lewis, G. N.
Michael, Arthur
Morley, E. W.
Noyes, A. A.
Noyes, W. A. (chairman, 1922).
Osborne, T. B.
Remsen, Ira
Richards, T. W.
Smith, Alexander
Smith, Edgar F.
Stieglitz, Julius
Wells, H. L.
Whitney, W. R.

6. GEOLOGY AND PALEONTOLOGY.

Branner, J. C.
Chamberlin, T. C.
Clarke, J. M.
Cross, Whitman
Dall, W. H.
Dana, E. S.
Davis, W. M.
Day, A. L. (chairman, 1924).
Kemp, J. F.
Leith, C. K.
Lindgren, Waldemar
Merriam, J. C.
Osborn, H. F.
Pumpelly, Raphael
Ransome, F. L.
Reid, H. F.
Schuchert, Charles
Scott, W. B.
Ulrich, E. O.
Vaughan, T. W.
Walcott, C. D.
Washington, H. S.
White, David.
Willis, Bailey

7. BOTANY.

Bailey, L. H. (chairman, 1924)
Britton, N. L.
Campbell, D. H.
Coulter, J. M.
Goodale, G. L.
Harper, R. A.
Jones, L. R.
Osterhout, W. J. V.
Robinson, B. L.
Sargent, C. S.
Setchell, W. A.
Smith, Erwin F.
Thaxter, Roland
Trelease, William

8. ZOOLOGY AND ANIMAL MORPHOLOGY.

Calkins, G. N.
Castle, W. E.
Chapman, F. M.
Conklin, E. G.
Davenport, C. B.
Donaldson, H. H.
Forbes, S. A.
Harrison, R. G.
Herrick, C. J.
Howard, L. O.
Jennings, H. S.
Lillie, F. R.
McClung, C. E.
Mark, E. L.
Mayor, A. G.
Merriam, C. H.
Morgan, T. H. (chairman, 1922).
Morse, E. S.
Parker, G. H.
Pearl, Raymond
Ridgway, Robert
Verrill, A. E.
Wheeler, W. M.
Wilson, Edmund B.

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9. PHYSIOLOGY AND PATHOLOGY.

Abel, J. J.	Halsted, W. S.	McCollum, E. V.
Armsby, H. P.	Hektoen, Ludvig	Mendel, L. B. (chairman, 1922).
Benedict, F. G.	Henderson, L. J.	Prudden, T. M.
Cannon, W. B.	Howell, W. H.	Smith, Theobald
Carlson, A. J.	Hunt, Reid	Van Slyke, D. D.
Chittenden, R. H.	Jones, Walter	Vaughan, V. C.
Councilman, W. T.	Levene, P. A. T.	Welch, W. H.
Cushing, Harvey	Loeb, Jacques	
Flexner, Simon	Lusk, Graham	
Folin, Otto	MacCallum, W. G.	

10. ANTHROPOLOGY AND PSYCHOLOGY.

Angell, J. R.	Fewkes, J. W. (acting chairman).	Hrdlicka, Ales
Boas, Franz	Hall, G. S.	Thorndike, E. L.
Cattell, J. McK	Holmes, W. H.	Woodworth, R. S.
Dewey, John		

STANDING COMMITTEES.

ON WEIGHTS, MEASURES, AND COINAGE.

Mendenhall, T. C. (chairman).	Michelson, A. A.	Webster, A. G.
	Morley, E. W.	Woodward, R. S.

ON SOLAR RESEARCH.

Hale, G. E. (chairman).	Michelson, A. A.	Nichols, E. L.
Campbell, W. W.		

ON PUBLICATION.

The President.	The Home Secretary.	Stratton, S. W.

EDITORIAL BOARD OF THE PROCEEDINGS.

The Home Secretary and the Foreign Secretary of the Academy, the Chairman of the Executive Board, and the Permanent Secretary of the National Research Council.

William Duane, 1923.	Arthur L. Day, 1922.	John M. Clarke, 1921.
R. G. Harrison, 1923.	Gano Dunn, 1922.	Ludvig Hektoen, 1921.
J. C. Merriam, 1923.	L. J. Henderson, 1922.	H. S. Jennings, 1921.
E. H. Moore, 1923.	W. J. V. Osterhout, 1922.	R. A. Millikan, 1921.
F. Schlesinger, 1923.	R. M. Yerkes, 1922.	W. A. Noyes, 1921.
W. M. Wheeler, 1923.	Augustus Trowbridge	C. A. Adams
F. G. Cottrell	E. B. Mathews	G. W. McCoy
C. E. McClung	Clark Wissler	F. L. Ransome

ON COLLECTION OF HISTORICAL PORTRAITS, MANUSCRIPTS, INSTRUMENTS, ETC.

Walcott, C. D. (chairman).	Clarke, F. W.	Pupin, M. I.
	Hale, G. E.	

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FINANCE COMMITTEE.

Ransome, F. L. (chairman). Cross, Whitman. Dunn, Gano. Walcott, C. D.

TRUST FUNDS.

THE BACHE FUND.

[$60,000.]

Researches in physical and natural science.

Frost, E. B. (chairman). Harrison, R. G. Webster, A. G.

THE WATSON FUND.

[$25,000.]

Watson medal and the promotion of astronomical research.

Leuschner, A. O. (chairman). Comstock, G. C. Elkin, W. L.

THE HENRY DRAPER FUND.

[$10,000.]

Draper medal and investigations in astronomical physics.

Campbell, W. W. (chairman), 1924. Abbot, C. G., 1926. Hale, G. E., 1923. Michelson, A. A., 1922. Russell, H. N., 1925.

THE J. LAWRENCE SMITH FUND.

[$10,000.]

J. Lawrence Smith medal and investigations of meteoric bodies.

Cross, Whitman (chairman), 1922. Adams, W. S., 1924. Dana, E. S., 1923. Schlesinger, F., 1925. Clarke, F. W., 1926.

THE BARNARD MEDAL.[1]

Meritorious service to science.

Noyes, A. A. (chairman). Campbell, W. W. Nichols, E. F. Morgan, T. H. Richards, T. W.

THE BENJAMIN APTHORP GOULD FUND.

[$20,000.]

Researches in astronomy.

Moulton, F. R. (chairman). Barnard, E. E. Woodward, R. S.

THE WOLCOTT GIBBS FUND.

[$5,545.50.]

Chemical research.

Jackson, C. L. (chairman). Richards, T. W. Smith, Edgar F.

[1] Every five years the committee recommends the person whom they consider most deserving of the medal, and upon the approval of the academy the name of the nominee is forwarded to the trustees of Columbia University, who administer the Barnard medal fund.

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THE COMSTOCK FUND.

[$12,406.02.]

Researches in electricity, magnetism, and radiant energy.

Nichols, E. L. (chairman), 1923. Millikan, R. A., 1926. Whitney, W. R., 1924.
Carty, J. J., 1925. Webster, A. G., 1922.

THE MARSH FUND.

[$20,000.]

Original research in the natural sciences.

Merriam, J. C. (chairman), 1922. Clarke, J. M., 1923.
Schuchert, Charles, 1924.

THE AGASSIZ FUND.

[$50,000.]

General uses of the academy.

THE MURRAY FUND.

[$6,000.]

Agassiz medal and contributions to oceanography.

Dall, W. H. (chairman), 1924. Davis, W. M., 1922. Mayor, A. G., 1923.

THE MARCELLUS HARTLEY FUND.

[$1,200.]

Medal for eminence in the application of science to the public welfare.

Noyes, A. A. (chairman), 1922. Stratton, S. W., 1922. Pupin, M. I., 1924.
Osborn, H. F., 1924. Welch, W. H., 1923.
Taylor, D. W., 1923.

THE DANIEL GIRAUD ELLIOT FUND.

[$8,000.]

Medal and honorarium for most meritorious work in zoology or paleontology published in each year.

Osborn, H. F. (chairman). [1] Lucas, F. A. Walcott, C. D.

THE MARY CLARK THOMPSON FUND.

[$10,000.]

Medal for most important services to geology and paleontology.

Clarke, J. M. (chairman), 1922. Lindgren, W., 1923. Osborn, H. F., 1924.

THE JOSEPH HENRY FUND.

[$40,000.]

To assist meritorious investigators, especially in the direction of original research.

Durand, W. F. (chairman). Davenport, C. B. Merriam, J. C.
Day, Arthur L. McClung, C. E.

[1] Not a member of the academy.

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MEMBERS OF THE NATIONAL ACADEMY OF SCIENCES.

JUNE. 30, 1921.

	Date of election.
Abbot, Charles Greeley, Smithsonian Institution, Washington, D. C	1915
Abbott, Henry L., U. S. Army, 23 Berkeley Street, Cambridge 38, Mass	1872
Abel, John Jacob, Johns Hopkins University, Baltimore, Md	1912
Adams, Walter Sydney, Solar Observatory Office, Pasadena, Calif	1917
Aitken, Robert Grant, Lick Observatory, Mount Hamilton, Calif	1918
Allen, J. Asaph, American Museum of Natural History, New York City	1876
Ames, Joseph S., Johns Hopkins University, Baltimore, Md	1909
Angell, James Rowland, Carnegie Corporation, New York City	1920
Armsby, Henry Prentiss, State College of Pennsylvania, Pa	1920
Bailey, Liberty Hyde, Ithaca, N. Y	1917
Bancroft, W. D., 7 East Avenue, Ithaca, N. Y	1920
Barnard, E. E., Yerkes Observatory, Williams Bay, Wis	1911
Barus, Carl, Brown University, Providence, R. I	1892
Baxter, Gregory Paul, T. J. Coolidge, jr., Memorial Laboratory, Cambridge, Mass	1916
Bell, A. Graham, 1331 Connecticut Avenue, Washington, D. C	1883
Benedict, Francis Gano, Nutrition Laboratory, Boston 17, Mass	1914
Birkhoff, George David, Harvard University, Cambridge, Mass	1918
Blichfeldt, Hans Frederick, Leland Stanford University, Calif	1920
Bliss, Gilbert Ames, University of Chicago, Chicago, Ill	1916
Boas, Franz, Columbia University, New York City	1900
Bogert, Marston Taylor, Columbia University, New York City	1916
Boltwood, B. B., Yale University, New Haven, Conn	1911
Bolza, Oskar, Reichsgrafenstr. 10, Freiburg, Germany	1909
Branner, John C., Stanford University, California	1905
Bridgeman, Percy Williams, Jefferson Physical Laboratory, Cambridge, Mass	1918
Britton, Nathaniel Lord, New York Botanical Gardens, New York City	1914
Calkins, Gary Nathan, Columbia University, New York City	1919
Campbell, D. H., Leland Stanford University, Calif	1910
Campbell, William W., Lick Observatory, Mount Hamilton, Calif	1902
Cannon, Walter Bradford, Harvard University, Cambridge, Mass	1914
Carlson, Anton Julius, University of Chicago, Chicago, Ill	1920
Carty, John J., American Telegraph & Telephone Co., New York City	1917
Castle, William Ernest, 186 Payson Road, Belmont, Mass	1915
Cattell, James McK., Garrison, N. Y	1901
Chamberlin, Thomas C., University of Chicago, Chicago, Ill	1903
Chandler, Charles F., Columbia University, New York City	1874
Chapman, Frank Michler, American Museum of Natural History, New York City	1921
Chittenden, Russell H., Sheffield Scientific School, New Haven, Conn	1890
Clarke, F. W., U. S. Geological Survey, Washington, D. C	1909
Clarke, J. M., State Museum, Albany, N. Y	1909
Comstock, George C., Washburn Observatory, Madison, Wis	1899

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	Date of election.
Conklin, E. G., Princeton, N. J	1908
Coulter, J. M., University of Chicago, Chicago, Ill	1909
Councilman, William T., Harvard Medical School, Boston, Mass	1904
Crew, Henry, Northwestern University, Evanston, Ill	1909
Cross, Whitman, 2138 Bancroft Place, Washington, D. C	1908
Curtis, Heber Doust, Allegheny Observatory, Pittsburgh, Pa	1919
Cushing, Harvey, Harvard University, Cambridge, Mass	1917
Dall, William H., Smithsonian Institution, Washington, D. C	1897
Dana, Edward S., Yale University, New Haven, Conn	1884
Davenport, Charles B., Cold Spring Harbor, N. Y	1912
Davis, William Morris, 31 Hawthorn Street, Cambridge 38, Mass	1904
Day, Arthur L., 2801 Upton Street, Washington, D. C	1911
Dewey, John, Columbia University, New York City	1910
Dickson, Leonard E., University of Chicago, Chicago, Ill	1913
Donaldson, Henry Herbert, Wistar Institute of Anatomy, Philadelphia, Pa	1914
Duane, William, Harvard University Medical School, Cambridge, Mass	1920
Dunn, Gano, 43 Exchange Place, New York City	1919
Durand, William Frederick, Leland Stanford University, Calif	1917
Elkin, William L., Yale University Observatory, New Haven, Conn	1917
Emmet, William Le Roy, General Electric Co., Schenectady, N. Y	1921
Fewkes, Jesse Walter, Bureau of American Ethnology, Washington, D. C	1914
Flexner, Simon, Rockefeller Institute, New York City	1908
Folin, Otto, Harvard Medical School, Boston, Mass	1916
Forbes, Stephen Alfred, Urbana, Ill	1918
Franklin, Edward Curtis, Leland Stanford University, Calif	1914
Freeman, John Ripley, Providence, R. I	1918
Frost, Edwin B., Yerkes Observatory, Williams Bay, Wis	1908
Gomberg, Moses, University of Michigan, Ann Arbor, Mich	1914
Gooch, Frank A., 291 Edwards Street, New Haven, Conn	1897
Goodale, George L., Harvard University, Cambridge, Mass	1890
Hale, George E., Solar Observatory Office, Pasadena, Calif	1902
Hall, Edwin H., Harvard University, Cambridge, Mass	1911
Hall, Granville Stanley, Clark University, Worcester, Mass	1915
Halsted, William Stewart, Johns Hopkins Medical School, Baltimore, Md	1917
Harkins, William Draper, University of Chicago, Chicago, Ill	1921
Harper, R. A., Columbia University, New York City	1911
Harrison, Ross G., Yale University, New Haven, Conn	1913
Hastings, Charles S., Yale University, New Haven, Conn	1889
Hayford, John F., Northwestern University, Evanston, Ill	1911
Hektoen, Ludvig, 637 South Wood Street, Chicago, Ill	1918
Henderson, Lawrence Joseph, Harvard University, Cambridge, Mass	1919
Herrick, Charles Judson, University of Chicago, Chicago, Ill	1918
Hillebrand, William F., Bureau of Standards, Washington, D. C	1908
Holmes, William H., U. S. National Museum, Washington, D. C	1905
Howard, Leland Ossian, U. S. Dept. of Agriculture, Washington, D. C	1916
Howe, Henry Marion, Broad Brook Road, Bedford Hills, N. Y	1917
Howell, William H., School of Hygiene and Public Health, Baltimore, Md	1905
Hrdlicka, Ales, United States National Museum, Washington, D. C	1921
Hunt, Reid, Harvard Medical School, Boston, Mass	1919
Jackson, Charles L., 383 Beacon Street, Boston, Mass	1883

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	Date of election.
Jennings, Herbert Spencer, Johns Hopkins University, Baltimore, Md	1914
Jewett, Frank Baldwin, Western Electric Co., New York, N. Y	1918
Johnson, Treat Baldwin, Yale University, New Haven, Conn	1919
Jones, Lewis Ralph, University of Wisconsin, Madison, Wis	1920
Jones, Walter, Johns Hopkins University, Baltimore, Md	1918
Kasner, Edward, Columbia University, New York City	1917
Kemp, James F., Columbia University, New York City	1911
Kennelly, Arthur Edwin, Harvard University, Cambridge, Mass	1921
Kohler, Elmer Peter, Harvard University, Cambridge, Mass	1920
Langmuir, Irving, General Electric Co., Schenectady, N. Y	1918
Leith, Charles Kenneth, University of Wisconsin, Madison, Wis	1920
Leuschner, Armin O., University of California, Berkeley, Calif	1913
Levene, Phœbus Aaron Theodor, Rockefeller Institute, New York City	1916
Lewis, Gilbert N., University of California, Berkeley, Calif	1913
Lillie, Frank Rattray, University of Chicago, Chicago, Ill	1915
Lindgren, Waldemar, Mass. Institute of Technology, Cambridge, Mass	1909
Loeb, Jacques, Rockefeller Institute, New York City	1910
Lusk, Graham, Cornell University Medical College, New York City	1915
Lyman, Theodore, Harvard University, Cambridge, Mass	1917
MacCallum, William George, Johns Hopkins Hospital, Baltimore, Md	1921
McClung, Clarence E., University of Pennsylvania, Philadelphia, Pa	1920
McCollum, Elmer Vernon, Johns Hopkins Med. School, Baltimore, Md	1920
Mark, Edward L., 109 Irving Street, Cambridge, Mass	1903
Mayor, Alfred Goldsborough, 276 Nassau Street, Princeton, N. J	1913
Mendel, Lafayette B., Yale University, New Haven, Conn	1913
Mendenhall, Charles Elwood, University of Wisconsin, Madison, Wis	1918
Mendenhall, Thomas C., 329 North Chestnut Street, Ravenna, Ohio	1887
Merriam, C. Hart, 1919 Sixteenth Street, Washington, D. C	1902
Merriam, John Campbell, Carnegie Institution, Washington, D. C	1918
Merritt, Ernest, Cornell University, Itaca, N. Y	1914
Michael, Arthur, 219 Parker Street, Newton Center, Mass	1889
Michelson, Albert A., University of Chicago, Chicago, Ill	1888
Miller, Dayton C., Case School of Applied Science, Cleveland, Ohio	1921
Miller, George Abram, University of Illinois, Urbana, Ill	1921
Millikan, Robert Andrews, California Inst. of Technology, Pasadena, Calif	1915
Moore, Eliakim H., University of Chicago, Chicago, Ill	1901
Morgan, T. H., Columbia University, New York City	1909
Morley, Edward W., West Hartford, Conn	1897
Morse, Edward S., Salem, Mass	1876
Moulton, F. R., University of Chicago, Chicago, Ill	1910
Nichols, Edward L., Cornell University, Ithaca, N. Y	1901
Nichols, Ernest F., Mass. Institute of Technology, Cambridge, Mass	1908
Noyes, Arthur A., California Institute of Technology, Pasadena, Calif	1905
Noyes, William A., University of Illinois, Urbana, Ill	1910
Osborn, H. F., American Museum of Natural History, New York City	1900
Osborne, T. B., Agricultural Experiment Station, New Haven, Conn	1910
Osgood, William Fogg, Harvard University, Cambridge, Mass	1904
Osterhout, Winthrop John Vanleuven, Harvard University, Cambridge, Mass	1919

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	Date of election.
Parker, George H., 16 Berkeley Street, Cambridge, Mass	1913
Pearl, Raymond, 625 St. Paul Street, Baltimore, Md	1916
Pierce, George Washington, Harvard University, Cambridge, Mass	1920
Prudden, T. Mitchell, 160 West 59th Street, New York City	1901
Pumpelly, Raphael, Gibbs Avenue, Newport, R. I	1872
Pupin, Michael I., Columbia University, New York City	1905
Ransome, Frederick Leslie, United States Geological Survey, Washington, D. C	1914
Reid, H. Fielding, Johns Hopkins University, Baltimore, Md	1912
Remsen, Ira, Johns Hopkins University, Baltimore, Md	1882
Richards, Theodore W., Wolcott Gibbs Memorial Laboratory, Cambridge, Mass	1899
Ridgway, Robert, 1030 South Morgan Street, Olney, Ill	1917
Robinson, Benjamin Lincoln, Harvard University, Cambridge, Mass	1921
Russell, Henry Norris, Princeton University, Princeton, N. J	1918
Ryan, Harris Joseph, Stanford University, Stanford, Calif	1920
Sargent, Charles S., Arnold Arboretum, Jamaica Plains, Mass	1895
Schlesinger, Frank, Yale University Observatory, New Haven, Conn	1916
Schuchert, Charles, Yale University, New Haven, Conn	1910
Scott, William B., Princeton University, Princeton, N. J	1906
Seares, Frederick Hanley, Mount Wilson Observatory, Pasadena, Calif	1919
Setchell, William Albert, University of California, Berkeley, Calif	1919
Slipher, Vesto Melvin, Lowell Observatory, Flagstaff, Ariz	1921
Smith, Alexander, Columbia University, New York City	1915
Smith, Edgar F., University of Pennsylvania, Philadelphia, Pa	1899
Smith, Erwin F., Bureau of Plant Industry, Washington, D. C	1913
Smith, Theobald, Rockefeller Institute for Medical Research, Princeton, N. J	1908
Squier, George Owen, Chief Signal Officer, United States Army, Washington, D. C	1919
Stebbins, Joel, University of Illinois Observatory, Urbana, Ill	1920
Stieglitz, Julius, University of Chicago, Chicago, Ill	1911
Stillwell, Lewis Buckley, 143 Liberty Street, New York City	1921
Story, William E., Clark University, Worcester, Mass	1908
Stratton, Samuel Wesley, Bureau of Standards, Washington, D. C	1917
Taylor, David Watson, Department of the Navy, Washington, D. C	1918
Thaxter, Roland, Harvard University, Cambridge, Mass	1912
Thomson, Elihu, Swampscott, Mass	1907
Thorndike, Edward Lee, Columbia University, New York City	1917
Trelease, William, University of Illinois, Urbana, Ill	1902
Trowbridge, Augustus, Princeton University, Princeton, N. J	1919
Trowbridge, John, Harvard University, Cambridge, Mass	1878
Ulrich, Edward Oscar, U. S. Geological Survey, Washington, D. C	1917
Van Slyke, Donald Dexter, Rockefeller Institute, New York City	1921
Van Vleck, E. B., University of Wisconsin, Madison, Wis	1911
Vaughan, T. Wayland, U. S. National Museum, Washington, D. C	1921
Vaughan, Victor Clarence, University of Michigan, Ann Arbor, Mich	1915
Veblen, Oswald, Princeton University, Princeton, N. J	1919
Verrill, A. E., 582 Central Avenue, Westville, Conn	1872

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	Date of election.
Walcott, Charles D., Smithsonian Institution, Washington, D. C.	1896
Washington, Henry Stephens, Geophysical Laboratory, Washington, D. C.	1921
Webster, Arthur G., Clark University, Worcester, Mass.	1903
Welch, William H., 807 St. Paul Street, Baltimore, Md.	1895
Wells, Horace L., Yale University, New Haven, Conn.	1903
Wheeler, William M., Harvard University, Cambridge, Mass.	1912
White, David, United States Geological Survey, Washington, D. C.	1912
White, Henry Seely, Vassar College, Poughkeepsie, N. Y.	1915
Whitney, Willis Rodney, General Electric Co., Schenectady, N. Y.	1917
Wilczynski, Ernest Julius, University of Chicago, Chicago, Ill.	1919
Willis, Bailey, Leland Stanford University, Stanford, Calif.	1920
Wilson, Edmund B., Columbia University, New York City	1899
Wilson, Edwin B., Massachusetts Institute of Technology, Cambridge, Mass.	1919
Wood, Robert W., Johns Hopkins University, Baltimore, Md.	1912
Woodward, Robert S., Carnegie Institution, Washington, D. C.	1896
Woodworth, Robert Sessions, Columbia University, New York City	1921

HONORARY MEMBER.

Smith, Sidney I., Yale University, New Haven, Conn	1884

FOREIGN ASSOCIATES.

Adams, Frank Dawson, McGill University, Montreal, Canada	1920
Arrhenius, S. A., Nobelinstitut, Stockholm	1908
Barrois, Charles, Université, Lille	1908
Bateson, William, John Innes Horticultural Institution, Merton Park, Surrey	1921
Brøgger, W. C., Universitet, Christiania	1903
De Vries, Hugo, Lunteren, Holland	1904
Deslandres, Henri, Astrophysical Observatory, Meudon	1913
Dewar, Sir James, University, Cambridge, England	1907
Eijkman, Christian, University of Utrecht, Utrecht, Holland	1921
Forsyth, A. R., Imperial College of Science and Technology, London	1907
Geikie, Sir Archibald, Haslemere, Surrey	1901
Groth, Paul von, Universität, Munich	1905
Heim, Albert, Zürich	1913
Hilbert, David, Universität, Göttingen	1907
Jordan, Marie Ennemond Camille, College of France, Paris	1920
Kapteyn, John C., Rijks Universiteit, Groningen	1907
Klein, Felix, Universität, Göttingen	1898
Kossel, Albrecht, Heidelberg	1913
Küstner, Karl Friedrich, Bonn	1913
Lacroix, François Antoine Alfred, Musée d'Histoire Naturelle, Paris	1920
Lankester, Sir E. Ray, South Kensington, London	1903
Larmor, Sir Joseph, St. Johns College, Cambridge	1908
Lorentz, Hendrik Anton, Rijks Universiteit, Leiden	1906
Onnes, Heike Kammerlingh, University of Leiden, Leiden	1920
Ostwald, Wilheim, Grossbothen bei Leipzig	1906
Pavlov, Ivan Petrovitch, Inst. for Experimental Medicine, Petrograd	1908
Penck, Albrecht, Universität, Berlin	1909
Picard, Charles Émile, Université, Paris	1903

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	Date of election.
Prain, Sir David, Royal Botanic Gardens, Kew, Surrey	1920
Ramon y Cajal, Santiago, University of Madrid, Madrid	1920
Rutherford, Sir Ernest, Newnham Cottage, Queen's Road, Cambridge	1911
Schuster, Sir Arthur, Yeldall, Twyford, Berkshire	1913
Seeliger, Hugo Ritter von, Universität, Munich	1908
Thomson, Sir Joseph, University, Cambridge	1930
Volterra, Vito, Università, Rome	1911
Van der Waals, Johannes D., Amsterdam	1913
Wolf, Max F. J. C., Heidelberg	1913

Deceased members.

	Date of election.	Date of death.		Date of election.	Date of death.
Abbe, Cleveland	1878	Oct. 28, 1916	Davidson, George	1874 [2]	Dec. 2, 1911
Agassiz, Alexander	1866	Mar. 27, 1910	Davis, Charles H.	(1)	Feb. 18, 1877
Agassiz, Louis	(1)	Dec. 14, 1873	Draper, Henry	1877	Nov. 20, 1882
Atkinson, George Francis	1918 [2]	Nov. 14, 1918	Draper, John W	1877	Jan. 4, 1882
Alexander, J. H.	(1)	Mar. 2, 1867	Dutton, C. E.	1884 [2]	Jan. 4, 1912
Alexander, Stephen	(1)	June 25, 1883	Eads, James B.	1872	Mar. 8, 1887
Bache, Alexander Dallas	(1)	Feb. 14, 1867	Emmons, Samuel F.	1892	Mar. 28, 1911
Baird, Spencer F.	1864	Aug. 19, 1887	Engelmann, George	(1)	Feb. 4, 1884
Barker, George F.	1876 [2]	May 24, 1910	Farlow, W. G.	1879 [2]	June 3, 1919
Barnard, F. A. P.	(1, 2)	Apr. 27, 1889	Ferrel, William	1868	Sept. 18, 1891
Barnard, J. G.	(1)	May 14, 1882	Fraser, John Frigs	(1)	Oct. 12, 1872
Barrell, Joseph	1919 [2]	May 4, 1919	Gabb, William M.	1876	May 30, 1878
Bartlett, W. H. C.	(1)	Feb. 11, 1893	Genth, F. A.	1872	Feb. 2, 1893
Becker, George Ferdinand	1901 [2]	Apr. 20, 1919	Gibbs, Josiah Willard	1879	Apr. 28, 1903
Beecher, Charles Emerson	1899	Feb. 14, 1904	Gibbs, Wolcott	(1)	Dec. 9, 1908
Billings, John S.	1883	Mar. 11, 1913	Gilbert, Grove Karl	1883 [2]	May 1, 1918
Bôcher, Maxime	1909 [2]	Sept. 12, 1918	Gill, Theodore Nicholas	1873	Sept. 25, 1914
Boss, Lewis	1889	Oct. 5, 1912	Gilliss, James Melville	(1)	Feb. 9, 1865
Bowditch, Henry P.	1887 [2]	Mar. 13, 1911	Goode, G. Brown	1888	Sept. 6, 1896
Brewer, William H.	1880 [2]	Nov. 2, 1910	Gould, Augustus A.	(1)	Sept. 15, 1866
Brooks, William Keith	1884	Nov. 12, 1908	Gould, Benjamin A.	(1, 2)	Nov. 26, 1896
Brown-Sequard, Chas. E.	1868	Apr. 2, 1894	Gray, Asa	(1)	Jan. 30, 1888
Brush, George Jarvis	1868 [2]	Feb. 6, 1912	Guyot, Arnold	(1)	Feb. 8, 1884
Bumstead, Henry A.	1913 [2]	Dec. 31, 1920	Hadley, James	1872	Nov. 14, 1872
Casey, Thomas L.	1890	Mar. 25, 1896	Hague, Arnold	1885	May 15, 1917
Caswell, Alexis	(1)	Jan. 8, 1877	Haldeman, S. S.	1876	Sept. 20, 1880
Chandler, Seth Carlo	1888 [2]	Dec. 31, 1913	Hall, Asaph	1875	Nov. 22, 1907
Chauvenet, William	(1)	Dec. 13, 1879	Hall, James	(1, 2)	Aug. 7, 1898
Clark, Henry James	1872	July 1, 1873	Hayden, F. V.	1873	Dec. 22, 1887
Clark, William B.	1908	July 27, 1917	Henry, Joseph	(1)	May 13, 1878
Coffin, James H.	1869	Feb. 6, 1873	Hilgard, Eugene W.	1872	Jan. 8, 1916
Coffin, J. H. C.	(1)	Jan. 8, 1890	Hilgard, Julius E.	(1)	May 9, 1890
Comstock, Cyrus B.	1884	May 29, 1910	Hill, George William	1874	Apr. 16, 1914
Cook, George H.	1887	Sept. 22, 1889	Hill, Henry B.	1883	Apr. 6, 1903
Cooke, Josiah P.	1872	Sept. 3, 1894	Hitchcock, Edward	(1)	Feb. 27, 1864
Cope, Edward D.	1872 [2]	Apr. 12, 1897	Holbrook, J. E.	1868	Sept. 8, 1871
Coues, Elliott	1877	Dec. 25, 1899	Holden, Edward Singleton	1885	Mar. 16, 1914
Crafts, James M.	1872	June 21, 1917	Hubbard, J. S.	(1)	Aug. 16, 1863
Dalton, J. C.	1864	Feb. 2, 1889	Humphreys, A. A.	(1)	Dec. 27, 1883
Dana, James D.	(1)	Apr. 14, 1895	Hunt, T. Stery	1873 [2]	Feb. 12, 1892

[1] Charter members, Mar. 3, 1863.

[2] Biographical memoirs have not been presented.

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Deceased members—Continued.

	Date of election.	Date of death.		Date of election.	Date of death.
Hyatt, Alpheus	1875	Jan. 15, 1902	Pourtales, L. F.	1873	July 19, 1880
Iddings, Joseph P.	1907 [2]	Sept. 8, 1920	Powell, John W.	1880	Sept. 23, 1902
James, William [2]	1903	Aug. 26, 1910	Putnam, Frederick W.	1885 [2]	Aug. 18, 1915
Johnson, S. W.	1866	July 21, 1909	Rodgers, John	(1)	May 5, 1882
Keeler, J. E.	1900	Aug. 12, 1900	Rogers, Fairman	(1)	Aug. 22, 1900
King, Clarence	1876	Dec. 24, 1901	Rogers, Robert E. [4]	(1)	Sept. 6, 1884
Kirtland, Jared P.	1865	Dec. 10, 1877	Rogers, William A.	1885	Mar. 1, 1898
Lane, J. Homer	1872	May 3, 1880	Rogers, William B. [5]	(1)	May 30, 1882
Langley, Samuel P.	1876	Feb. 27, 1906	Rood, Ogden N.	1865	Nov. 12, 1902
Lea, Matthew Carey	1892	Mar. 15, 1897	Rosa, E. B.	1913 [2]	May 17, 1921
Le Conte, John	1878	Apr. 29, 1891	Rowland, Henry A.	1881	Apr. 16, 1901
Le Conte, John L.	(1)	Nov. 15, 1883	Royce, Josiah	1906 [2]	Sept. 14, 1916
Le Conte, Joseph	1875	July 6, 1901	Rutherfurd, Lewis M.	(1)	May 30, 1892
Leidy, Joseph	(1)	Apr. 30, 1891	Sabine, Wallace C. W.	1917 [2]	Jan. 10, 1919
Lesley, J. Peter	(1)	June 1, 1903	Saxton, Joseph	(1)	Oct. 26, 1873
Lesquereux, Leo.	1864	Oct. 20, 1889	Schott, Charles A.	1872	July 31, 1901
Longstreth, Miers F.	(1)	Dec. 27, 1891	Scudder, Samuel H.	1877 [2]	May 17, 1911
Loomis, Elias	1873	Aug. 15, 1889	Sellers, William	1873 [2]	Jan. 24, 1905
Lovering, Joseph	1873	Jan. 18, 1892	Silliman, Benj., sr	(1)	Nov. 24, 1864
Lyman, Theodore	1872	Sept. 9, 1897	Silliman, Benj., jr	(1)	Jan. 14, 1885
Mahan, D. H.	(1)	Sept. 16, 1871	Smith, J. Lawrence	1872	Oct. 12, 1883
Mall, Franklin P.	1907 [2]	Nov. 17, 1917	Smith, Richmond Mayo	1890 [2]	Nov. 11, 1901
Marsh, G. P.	1866	July 23, 1882	Stimpson, William	1868	May 26, 1872
Marsh, O. C.	1874 [2]	Mar. 18, 1899	Strong, Theodore	(1)	Feb. 1, 1889
Mayer, Alfred M.	1872	July 13, 1897	Sullivant, W. S.	1872	Apr. 30, 1873
Meek, F. B.	1869	Dec. 21, 1876	Torrey, John	(1)	Mar. 10, 1873
Meigs, M. C.	1865	Jan. 2, 1892	Totten, J. G.	(1)	Apr. 22, 1864
Meltzer, Samuel James	1912 [2]	Nov. 8, 1920	Trowbridge, William P.	1872	Aug. 12, 1892
Minot, Charles Sedgwick	1897	Nov. 19, 1914	Trumbull, James H.	1872	Aug. 5, 1897
Mitchell, Henry	1885 [2]	Dec. 1, 1902	Tuckerman, Edward	1868	Mar. 15, 1886
Mitchell, Silas Weir	1865	Jan. 4, 1914	Van Hise, C. R.	1902 [2]	Nov. 19, 1918
Morgan, Lewis H.	1875	Dec. 17, 1881	Walker, Francis A.	1878	Jan. 5, 1897
Morse, Harmon N.	1907 [2]	Sept. 8, 1920	Warren, G. K.	1876	Aug. 8, 1882
Morton, Henry	1874	May 9, 1902	Watson, James C.	1868	Nov. 23, 1880
Nef, John Ulric	1904 [2]	Aug. 13, 1915	Watson, Sereno	1889	Mar. 9, 1892
Newberry, J. S.	(1)	Dec. 7, 1892	Wheeler, Henry Lord	1909 [2]	Oct. 30, 1914
Newcomb, Simon	1869 [2]	July 11, 1909	White, Charles A.	1889	June 29, 1910
Newton, H. A.	(1)	Aug. 12, 1896	Whitman, C. O.	1895	Dec. 6, 1910
Newton, John	1876	May 1, 1895	Whitney, Josiah D. [3]	(1, 3)	Aug. 19, 1896
Norton, William A.	1873	Sept. 21, 1883	Whitney, William D. [3]	1865 [2]	June 29, 1894
Oliver, James E.	1872	Mar. 27, 1895	Williston, Samuel W.	1915 [2]	Aug. 30, 1918
Packard, A. S.	1872	Feb. 14, 1905	Winlock, Joseph	(1)	June 11, 1875
Penfield, Samuel L.	1900	Aug. 13, 1906	Wood, Horatio C.	1879 [2]	Jan. 3, 1920
Peters, C. H. F.	1876 [2]	July 18, 1890	Woodward, J. J.	1873	Aug. 17, 1884
Peirce, Benjamin [2]	(1, 2)	Oct. 6, 1880	Worthen, A. H.	1872	May 6, 1888
Peirce, Benjamin Osgood	1906	Jan. 14, 1914	Wright, Arthur Williams	1881 [2]	Dec. 19, 1915
Pickering, Edward C.	1873 [2]	Feb. 3, 1919	Wyman, Jeffries	(1)	Sept. 4, 1874
Pierce, Charles S. S.	1876 [2]	Apr. 20, 1914	Young, Charles A.	1872	Jan. 3, 1908
Pirsson, Louis V.	1913 [2]	Dec. 8, 1919			

[1] Charter members, Mar. 3, 1863
[2] Biographical memoirs have not been presented.
[3] Resigned 1873.
[4] Dropped —, reelected 1875.
[5] Dropped —, reelected 1872.

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DECEASED FOREIGN ASSOCIATES.

Adams, J. C.
Airy, Sir George B.
Argelander, F. W. A.
Auwers, G. F. J. Arthur
Backlund, Oskar
Baer, Karl Ernest von
Baeyer, Adolf von
Barrande, Joachin
Beaumont, L. Élie de
Becquerel, Henri
Berthelot, M. P. E.
Bertrand, J. L. F.
Boltzmann, Ludwig
Bornet, Edouard
Boussingault, J. B. J. D.
Boveri, Theodor
Braun, Alexander
Brewster, Sir David
Bunsen, Robert W.
Burmeister, C. H. C.
Candolle, Alphonse de
Cayley, Arthur
Chasles, Michel
Chevreul, M. E.
Clausius, Rudolph
Cornu, Alfred
Crookes, Sir William
Darboux, Gaston
Darwin, Sir George Howard
Dove, H. W.
Dumas, J. B.
Ehrlich, Paul
Faraday, Michael
Fischer, Emil
Gegenbaur, Karl
Glydén, Hugo
Gill, Sir David
Hamilton, Sir William Rowan
Helmholtz, Baron H. von
Hoff, J. H. van't
Hofmann, A. W.
Hooker, Sir Joseph D.
Huggins, Sir William
Huxley, T. H.
Ibañez, Carlos
Janssen, J.
Joule, James P.
Kekulé, August
Kelvin, Lord
Kirchoff, G. R.
Koch, Robert
Kölliker, Albert von
Kohlrausch, Friedrich
Kronecker, Hugo
Lacaze-Duthiers, Henri de
Leuckart, Rudolph
Lie, Sophus
Liebig, Justus von
Lister, Lord
Loewy, Maurice
Ludwig, K. F. W.
Marey, E. J.
Mendeléeff, D. I.
Milne-Edwards, Henri
Moissan, Henri
Murchison, Sir Roderick I.
Murray, Sir John
Oppolzer, Theodore von
Owen, Sir Richard
Pasteur, Louis
Peters, C. A. F.
Pfeffer, Wilhelm
Plana, G. A. A.
Poincaré, Jules Henri
Rammelsberg, C. F.
Ramsay, Sir William
Rayleigh, Lord
Regnault, Victor
Retzius, Gustav
Reymond, Emil Du Bois
Richthofen, F. von
Rosenbusch, Karl Harry Ferdinand
Sachs, Julius von
Schiaparelli, Giovanni
Stas, Jean Servais
Stokes, Sir George G.
Strasburger, Edouard
Struve, Otto von
Suess, Eduard
Sylvester, J. J.
Tisserand, F. F.
Virchow, Rudolph von
Vogel, H. C.
Waldeyer, Wilhelm
Weierstrass, Karl
Weismann, August
Wöhler, Friedrich
Wundt, Wilhelm
Würtz, Adolph
Zirkel, Ferdinand
Zittell, K. A. R. von

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REPORT

OF THE

NATIONAL ACADEMY OF SCIENCES

FOR THE YEAR

1922

WASHINGTON
GOVERNMENT PRINTING OFFICE
1923

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REPORT

OF THE

NATIONAL ACADEMY OF SCIENCES

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1922

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1923

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CONTENTS.

	Page.
Letter of transmittal	vii
Act of incorporation	viii
Amendments	ix
Introduction	xi
Meetings of the National Academy of Sciences	1
Autumn meeting	1
Business session	1
President's announcements	1
Trust funds	2
New building	2
Research fund reports	2
J. Lawrence Smith fund	2
Henry Draper fund	3
Joseph Henry fund	4
Metric system of weights and measures	4
Scientific sessions	6
November 14	6
November 15	7
Annual meeting	8
Members in attendance	8
Business sessions	8
Announcements of appointments	8
Trust fund committees	9
Chairman of sections	9
Members of committees	9
Delegates	9
Report of committee on weights, coinage, and measures	10
Report of the treasurer	10
Report of the home secretary	10
Amendment to Constitution	11
Amendment to rules	11
Research fund reports	11
Bache fund	11
Watson fund	13
Draper fund	13
J. Lawrence Smith fund	14
Wolcott Gibbs fund	15
Comstock fund	15
Murray fund	15
Elliot fund	15
Mary Clark Thompson fund	16
Marsh fund	16
Gould fund	17
Joseph Henry fund	17
Recommendations from the council	17
Elections	18

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Page.
Scientific sessions 19
April 24 19
April 25 20
Presentation of medals 21
Report of the National Research Council 22
Introduction 22
Relations to the National Academy of Sciences 24
Relations to the Engineering Foundation 24
Financial support 25
New building 26
Officers for 1922–23 27
International relations 27
Proceedings of the National Academy of Sciences 28
Publications 28
Bulletin of the National Research Council 28
Reprint and circular series 29
Fellowships 31
Federation of biological societies 32
Concilium Bibliographicum 33
Personal Research Federation 34
Science Service 35
American scientific literature for Russian scientific institutions 36
Reports of divisions 37
Division of federal relations 37
Division of foreign relations 38
Delegates to 1922 meetings 38
International Research Council 39
International Astronomical Union 39
International Geodetic and Geophysical Union 39
International Union of Pure and Applied Chemistry 39
International Union of Scientific Radio-Telegraphy 39
International Geological Congress 40
Division of states relations 41
Division of educational relations 42
Division of research extension 44
Research information service 45
Division of physical sciences 49
Division of engineering 50
Division of chemistry and chemical technology 53
Division of geology and geography 58
Division of medical sciences 62
Division of biology and agriculture 64
Division of anthropology and psychology 68
Appendix A 71
Officers, members and committees 71
Divisions of the council 71
Division of federal relations 71
Division of foreign relations 72
Division of states relations 73
Division of educational relations 74
Division of research extension 74
Research information service 75
Division of physical sciences 75

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Report of the National Research Council—Continued.
Appendix A—Continued.
Divisions of the council—Continued. Page.
Division of engineering 84
Division of chemistry and chemical technology 87
Division of geology and geography 89
Division of medical sciences 90
Division of biology and agriculture 92
Division of anthropology and psychology 95
Fellowships 96
Research fellowship board 96
Appendix B 98
Articles of organization 98
Report of the Treasurer 101
National Academy of Sciences 101
Trust funds of the academy 103
Assets 104
Liabilities 107
Accounts with individual funds 110
National Research Council 115
Receipts and disbursements 116
Report of the auditing committee 120
Biographical notes 121
John Casper Branner 121
Appendix A 126
Constitution of the National Academy of Sciences 126
Appendix B 133
Rules 133
Appendix C 139
Organization of the academy 139
Members 145
Foreign associates 149
Medalists 150
Deceased members 150
Deceased foreign associates 152
Deceased medalists 153

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LETTER OF TRANSMITTAL.

NATIONAL ACADEMY OF SCIENCES,
Washington, D. C., December 29, 1922.

SIR: I have the honor to transmit to you herewith the report of the president of the National Academy of Sciences for the fiscal year ended June 30, 1922.

Very respectfully,

CHARLES D. WALCOTT,
President.

HON. CALVIN COOLIDGE,
Vice President of the United States.

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ACT OF INCORPORATION.

AN ACT To incorporate the National Academy of Sciences.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That Louis Agassiz, Massachusetts; J. H. Alexander, Maryland; S. Alexander, New Jersey; A. D. Bache, at large; F. B. Barnard,[1] at large; J. G. Barnard, United States Army, Massachusetts; W. H. C. Bartlett, United States Military Academy, Missouri; U. A. Boyden,[2] Massachusetts; Alexis Caswell, Rhode Island; William Chauvenet, Missouri; J. H. C. Coffin, United States Naval Academy, Maine; J. A. Dahlgren,[2] United States Navy, Pennsylvania; J. D. Dana, Connecticut; Charles H. Davis, United States Navy, Massachusetts; George Englemann, Saint Louis, Missouri; J. F. Frazer, Pennsylvania; Wolcott Gibbs, New York; J. M. Giles,[3] United States Navy, District of Columbia; A. A. Gould, Massachusetts; B. A. Gould, Massachusetts; Asa Gray, Massachusetts; A. Guyot, New Jersey; James Hall, New York; Joseph Henry, at large; J. E. Hilgard, at large, Illinois; Edward Hitchcock, Massachusetts; J. S. Hubbard, United States Naval Observatory, Connecticut; A. A. Humphreys, United States Army, Pennsylvania; J. L. Le Conte, United States Army, Pennsylvania; J. Leidy, Pennsylvania; J. P. Lesley, Pennsylvania; M. F. Longstreth, Pennsylvania; D. H. Mahan, United States Military Academy, Virginia; J. S. Newberry, Ohio; H. A. Newton, Connecticut; Benjamin Peirce, Massachusetts; John Rodgers, United States Navy, Indiana; Fairman Rogers, Pennsylvania; R. E. Rogers, Pennsylvania; W. B. Rogers, Massachusetts; L. M. Rutherford, New York; Joseph Saxton, at large; Benjamin Silliman, Connecticut; Benjamin Silliman, junior, Connecticut; Theodore Strong, New Jersey; John Torrey, New York; J. G. Totten, United States Army, Connecticut; Joseph Winlock, United States Nautical Almanac, Kentucky; Jeffries Wyman, Massachusetts; J. D. Whitney, California; their associates and successors duly chosen, are hereby incorporated, constituted, and declared to be a body corporate, by the name of the National Academy of Sciences.

SEC. 2. *And be it further enacted,* That the National Academy of Sciences shall consist of not more than fifty ordinary members, and

[1] The official list of members gives the name of F. A. P. Barnard.
[2] Declined.
[3] The official list of members gives the name of J. M. Gillis.

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the said corporation hereby constituted shall have power to make its own organization, including its constitution, by-laws, and rules and regulations; to fill all vacancies created by death, resignation, or otherwise; to provide for the election of foreign and domestic members, the division into classes, and all other matters needful or usual in such institution, and to report the same to Congress.

SEC. 3. *And be it further enacted*, That the National Academy of Sciences shall hold an annual meeting at such place in the United States as may be designated, and the academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art, the actual expense of such investigations, examinations, experiments, and reports to be paid from appropriations which may be made for the purpose, but the academy shall receive no compensation whatever for any services to the Government of the United States.

SOLOMON FOOTE,
President of the Senate pro tempore.
GALUSHA A. GROW,
Speaker of the House of Representatives.

Approved, March 3, 1863.
ABRAHAM LINCOLN, *President.*

AMENDMENTS.

AN ACT To amend the act to incorporate the National Academy of Sciences.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the act to incorporate the National Academy of Sciences, approved March third, eighteen hundred and sixty-three, be, and the same is hereby, so amended as to remove the limitation of the number of ordinary members of said academy as provided in said act.

Approved, July 14, 1870.

AN ACT To authorize the National Academy of Sciences to receive and hold trust funds for the promotion of science, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the National Academy of Sciences, incorporated by the act of Congress approved March third, eighteen hundred and sixty-three, and its several supplements, be, and the same is hereby, authorized and empowered to receive bequests and donations and hold the same in trust, to be applied by the said academy in aid of scientific investigations and according to the will of the donors.

Approved, June 20, 1884.

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AN ACT To amend the act authorizing the National Academy of Sciences to receive and hold trust funds for the promotion of science, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the act to authorize the National Academy of Sciences to receive and hold trust funds for the promotion of science, and for other purposes, approved June twentieth, eighteen hundred and eighty-four, be, and the same is hereby, amended to read as follows:

"That the National Academy of Sciences, incorporated by the act of Congress approved March third, eighteen hundred and sixty-three, be, and the same is hereby, authorized and empowered to receive, by devise, bequest, donation, or otherwise, either real or personal property, and to hold the same absolutely or in trust, and to invest, reinvest, and manage the same in accordance with the provisions of its constitution, and to apply said property and the income arising therefrom to the objects of its creation and according to the instructions of the donors: *Provided, however*, That the Congress may at any time limit the amount of real estate which may be acquired and the length of time the same may be held by said National Academy of Sciences."

SEC. 2. That the right to alter, amend, or repeal this act is hereby expressly reserved.

Approved, May 27, 1914.

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NATIONAL ACADEMY OF SCIENCES.

In 1863 Henry Wilson, United States Senator from Massachusetts, later Vice President of the United States, asked a number of men eminent in science to come together to form an organization by which the scientific strength of the country might be brought to the aid of the Government. This meeting was directly the result of an act of Congress passed March 3, 1863, incorporating the National Academy of Sciences of the United States of America. While Senator Wilson presumably had aid and suggestions from the incorporators, the bill had its inception with and was drawn by him, and did not incorporate the academy in any State or Territory or in the District of Columbia. It seems to have been his idea that the academy should be national in its broadest sense.

The academy has held its annual meetings in Washington at the Smithsonian Institution and its autumn meetings in other cities. Joseph Henry was president for many years and at the same time secretary of the institution. The records and library of the academy have been stored in several hundred boxes at the institution, awaiting such time as the academy may have a building of its own where this material can be made available.

The semicentennial in 1913 seemed to give new life to the activities of the academy, and the foreign secretary, Dr. George E. Hale, proposed then that the academy should have a home. He prepared tentative plans and had them put in shape at his own expense by an architect who could appreciate the need for and the requirements of a research institution. This building as proposed provided laboratories and a library for the use of the academy and resident men of science for research work. The one serious drawback which delayed its consummation was lack of funds.

The project was not to be long delayed, for the World War coming in 1914 changed and broadened the thought of the world. What started to be a battle of armed forces turned to competition between the countries at war in creative scientific research, looking to the destruction of masses instead of individuals. This led to the need in this country of a body that could bring together the most able men in the fields of science for the solution of war problems. Doctor Hale, conceiving the need for such a service long before it was an actual necessity, proposed that the academy take preliminary steps in the organization of the scientific resources of the United States,

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and this was the beginning of the National Research Council which rendered such effective service at the request of the President of the United States during the war.

Appreciation of this war service of the academy was shown in an Executive order issued by President Wilson, requesting the National Academy of Sciences to continue the council. Under this order the research council was reorganized on a permanent peace basis as an agent of the academy, and the need of the academy for a home was accentuated. Doctor Hale's previous plans were discussed at length, but the obstacle of lack of money continued. The quarters in the Smithsonian Institution, already too crowded, could not afford room for this new body, and temporary space elsewhere was sought. During the war a few rooms in the Munsey Building on the north side of E Street, between Thirteenth and Fourteenth, were first occupied. Later a residence at Sixteenth and L Streets, having 21 rooms, was secured. Still later, a larger building, at Sixteenth and M Streets, was occupied until the present location at Seventeenth and Massachusetts Avenue was leased.

Efforts were made to secure a permanent endowment and money for a building for the academy, and a suggestion was made to the Carnegie Corporation of an endowment and a building for the academy and research council, resulting in an offer of $5,000,000 provided the academy would secure a site. The amount needed for the purchase of this site was apportioned, so that the entire country might have a part in this great enterprise. With this plan in view, the raising of funds for the purchase of the ground was accomplished through the efforts of Doctor Hale, Doctor Millikan, and others.

The lot purchased by the academy is known as square 88, which is bounded on the north by C Street, on the west by Twenty-second Street, on the east by Twenty-first Street, and on the south by Upper Water Street. It has had considerable filling. Originally its highest point was in the northwest corner, and its lowest point was under water in the river at the southeast. To-day its lowest point is about 24 feet above high water and its highest 41 feet. The borings show that there is a fill of from 5 to 10 feet where the building will stand, resting on from 6 to 28 feet of clay and sand, and from 7 inches to 3 feet of decomposed rock. Below this last is good rock upon which the foundations of the building will rest.

With the acquiring of the site and its acceptance by the Carnegie Corporation, attention was given immediately to the securing of an architect, and in 1919 Mr. Bertram Grosvenor Goodhue, of New York, was selected and requested to make tentative plans along certain lines which the building committee had in mind. After consideration of other designs the plans finally reverted to the classical style for a building three stories in height.

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The main entrance will face B Street, halfway between Twenty-first and Twenty-second Streets. A broad walk with reflecting pools in the center will lead through a formal effect of trees and shrubs to the building surmounting a series of terraces, in the middle of the square. A deep terrace of stone surrounded by a massive railing of marble will extend the entire length of the front. Two magnificent marble and bronze lamps, one on each side of the entrance, are to symbolize enlightenment that will come from within. A frieze inscribed with the names of distinguished men of science will add its inspiration.

Massive bronze doors will open upon surroundings that invite further inspection. The vestibule, with walls and floors of marble, is to lead to a great entrance hall, also of marble, but of warmer tone. On one side of the hall there will be a seismograph, on the other side a magnetograph, giving automatic and continuous records.

In the rotunda there will be in actual operation apparatus demonstrating certain fundamental facts hitherto but vaguely appreciated by many. A coelostat telescope, mounted on the dome of the central rotunda, will form a large image of the sun on the white surface of a circular table in the middle of the room. Here the sun spots may be seen, changing in number and form from day to day and moving across the disk as the sun turns on its axis. A 60-foot pendulum, similar to that exhibited by Foucault at the Pantheon at Paris in 1851, will be suspended from the center of the dome, demonstrating by its oscillations his celebrated experiment showing the diurnal motion of the earth.

This large hall, rich in its warmth of treatment of color, will be surrounded by five exhibition rooms in which will be shown the results of future work of the academy and research council. The library, with its impressive shelves filled with volumes printed in many languages and covering all branches of scientific effort, will be on the same floor, with a quiet reading room just beyond. To the east will be situated the lecture room and the conference room for smaller meetings.

In the west front of the basement of the building there will be a room under the library for additional library stacks. On the east a room that may be used as a dining room or for entertainment at any of the functions that may be held by the academy or research council. Under the entrance hall is to be another exhibition room; and north of that, the boiler rooms and other appliances for heating and ventilating, storage rooms, etc. The second and third floors will contain 57 rooms which will be used for the administrative offices of the National Academy of Sciences and the National Research Council.

The building has a frontage of 260 feet and is 140 feet deep. The height above the first floor is 60 feet. The vestibule is 11 by 20 feet;

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the entrance hall, 36 by 21 feet; the central hall, 64 by 24 feet; the library, 36 by 64 feet; the lecture room, 34 by 50 feet. The five exhibition halls range in size from 26 by 14 to 34 by 21 feet.

The total number of square feet of floor space, exclusive of elevators, doorways, and hallways, is 39,874. This includes exhibition space, amounting to 14,571 square feet, lecture and entertainment space of 7,982, and 14,786 square feet for administrative purposes. Every modern convenience and facility will be provided.

This building for the National Academy of Sciences and the National Research Council is to be the focus of science in America and will be looked upon by our fellow citizens and the world at large as emblematic of all the creative mind will be able to do to bring about a better existence for the future people of the world, for it is to their enlightenment and advancement that it is dedicated.

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ANNUAL REPORT OF THE NATIONAL ACADEMY OF SCIENCES.

MEETINGS OF THE NATIONAL ACADEMY.

AUTUMN MEETING.

The autumn meeting of the academy was held at the University of Chicago, November 14, 15, and 16, 1921.

BUSINESS SESSION.

Twenty-eight members responded to roll call, as follows:

Barnard, E. E.	Frost, E. B.	Moore, E. H.
Bliss, G. A.	Harkins, W. D.	Moulton, F. R.
Carlson, A. J.	Hektoen, Ludvig	Noyes, W. A.
Chamberlin, T. C.	Herrick, C. J.	Pearl, Raymond
Comstock, G. C.	Leuschner, A. O.	Slipher, V. M.
Coulter, J. M.	Lillie, F. R.	Stebbins, Joel
Crew, Henry	Mendenhall, C. E.	Stieglitz, Julius
Dickson, L. E.	Michelson, A. A.	Van Vleck, E. B.
Donaldson, H. H.	Miller, G. A.	Wilson, Edwin B.
Forbes, S. A.		

PRESIDENT'S ANNOUNCEMENTS.

Announcement was made of the following deaths and assignments for preparation of biographical memoirs of deceased members:

To Theodore Lyman, the biography of E. B. Rosa, elected 1913, died May 17, 1921.

To F. M. Chapman, the biography of J. A. Allen, elected 1876, died August 29, 1921.

To Liberty H. Bailey, the biography of H. P. Armsby, elected 1920, died October 19, 1921.

The apointment of the following delegates was announced:

Arthur L. Day to the inauguration of James Rowland Angell as president of Yale University, June 22, 1921.

Henry Prentiss Armsby to the inauguration of President Thomas, of Pennsylvania State College, October 1, 1921.

J. Walter Fewkes to the inauguration of Julian Alvin Carroll Chandler as president of William and Mary College, October 19, 1921.

H. H. Donaldson to the inauguration of Frank Aydelotte as president of Swarthmore College, October 22, 1921.

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The receipt was announced of the following gifts:

From the University of Virginia, a bronze medal in commemoration of the centennial anniversary of its foundation.

From the Wisconsin Academy of Sciences, Arts, and Letters, a bronze medallion in commemoration of its semicentennial anniversary.

From the trustees of the William Ellery Hale Fund, the sum of $1,000 for the support of the Proceedings.

TRUST FUNDS.

On account of trust funds, the following receipts were announced:

From the Pennsylvania Co. for Insurances on Lives and Granting Annuities, on account of the Joseph Henry Fund:

Principal	$17,539.57	
Income	1,311.41	
		$18,850.98

From the executors of the estate of Mary Anna Palmer Draper, on account of the Billings Fund: Principal, $3,750; making a total of $19,250.

NEW BUILDING.

The following report was presented by the joint committee on the building of the National Academy of Sciences and National Research Council:

Blue-print plans of the new building for the National Academy and the National Research Council from the architect, Bertram Grosvenor Goodhue, were shown to the academy and met with approval. It was stated that work on these plans would be completed within a very short time, when contracts for the building would be drawn.

RESEARCH FUNDS.

J. LAWRENCE SMITH FUND.

The following report from the committee on the J. Lawrence Smith Fund was presented:

The committee of the academy on the J. Lawrence Smith Fund recommends that the gold medal provided for by this fund be awarded at the annual meeting in April, 1922, to Dr. George Perkins Merrill, United States National Museum, for his important contributions to knowledge concerning the character of meteorites. Doctor Merrill's investigations have extended over many years, and the list of his published papers embraces more than 50 titles. His work has been notable for its scope and thoroughness and the philosophical standpoint from which it has been conducted. His object has been to contribute toward the solution of the problem of the origin and significance of these extraterrestrial bodies.

Doctor Merrill's researches have been concerned with the mineral, chemical, and textural characters of both metallic and stony meteorites and with the interpretation of these properties. It is the opinion of the committee that Doctor Merrill is to-day the most eminent investigator of meteorites in the world and richly deserves the honor recommended. Many of his more recent and specially valuable results have

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been secured with the aid of grants from the J. Lawrence Smith fund, which have been judiciously expended.

The deed of gift of the J. Lawrence Smith fund indicates that the medal award stood very prominently in the donor's mind. In fact, it has been awarded but once, namely, in 1888 to H. A. Newton, of the Yale observatory, "for observations of the orbits of meteorites."

The committee recommends that a grant of $500 be made to Dr. George P. Merrill, United States National Museum, from the accumulated income of the J. Lawrence Smith fund, in aid of further investigations on the character of meteorites. The committee feels that the excellent use made of previous grants is ample assurance that this grant will be well spent. No other application for a grant is before the committee.

It is respectfully requested that the academy take action on both of the above recommendations.

For the committee.

WHITMAN CROSS, *Chairman.*

Received. Award of medal and grant approved.

HENRY DRAPER FUND.

The following report was presented from the committee on the Henry Draper fund:

The Henry Draper committee recommends that the Henry Draper gold medal of the academy be awarded to Prof. Henry Norris Russell at the next stated meeting of the academy. The chief reason for the award lies in the remarkably valuable contributions which Professor Russell has made to our knowledge of the processes of stellar evolution and the underlying causes therefor. Upon receipt of information that the recommendation of the committee has been confirmed by the council, a fuller statement of reasons governing the award will be supplied for use at the next stated meeting and for publication in the minutes thereof.

W. W. CAMPBELL, *Chairman.*

Recommendation approved.

WATSON FUND.

The following report from the trustees of the James Craig Watson fund was presented:

The trustees of the James C. Watson fund respectfully recommend that the following grants be authorized:

Five hundred dollars to Dr. William Bowie, United States Coast and Geodetic Survey, for the continuation of observations of the variation of latitude at the international latitude observatory at Ukiah, Calif.

Five hundred dollars to the Lick Observatory, Mount Hamilton, Calif., as a contribution to the sum of $4,000 required for a Ross photographic zenith telescope for a study of latitude variations under the direction of W. W. Campbell in connection with an astronomical, geodetic, seismological, and geological research project concerning the northerly movement of a section of the Pacific coast recently discovered by Prof. A. C. Lawson, of the University of California.

A. O. LEUSCHNER, *Chairman.*
W. L. ELKIN.
GEORGE C. COMSTOCK.

Grants approved.

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JOSEPH HENRY FUND.

The committee on the Joseph Henry fund presented the following recommendations:

The committee on the Henry fund desires to submit for the approval of the academy the following general statement regarding its proposed policy in the administration of this fund:

The terms of the deed of gift provide that after the death of the last survivor of the immediate family of Professor Henry the capital sum shall be transferred to the National Academy of Sciences, to be forever held in trust, and the income from which shall be from time to time applied to assist "meritorious investigations in natural science, especially in the direction of original research."

Under these terms there is imposed no limitation regarding the field of science in which an award may be made. Since, however, this fund in its original inception was organized during Professor Henry's lifetime for the purpose of enabling him the better to carry on his scientific work, and since it now stands, in some measure, as a monument to his name and to his contributions to science, it would seem not improper that, among projects of equal merit otherwise, some preference should be shown to those which may lie nearer to the fields of work with which Professor Henry's name is usually associated. The committee does not, however, desire to impose in advance any specific limitation or restriction, and it will therefore be prepared to consider applications from all fields of natural science.

W. F. DURAND, *Chairman.*

Approved.

The committee on the Henry fund desires further to recommend as follows:

That, of the amount of interest thus far received and amounting to $1,311.41, the sum of $388.32 be transferred to the capital account, thus bringing the present valuation of the fund ($39,611.68) up to the original face value of $40,000.

W. F. DURAND, *Chairman.*

Transfer approved.

In accordance with application, a copy of which is attached hereto, the committee of the Henry fund desires to recommend for the approval of the academy:

Grant No. 1. To the Lick Observatory, Mount Hamilton, Calif., Dr. W. W. Campbell, director, the sum of $500, as a contribution toward the sum of $4,000 required for a Ross photographic zenith telescope for latitude variation study.

W. F. DURAND, *Chairman.*

Grant approved.

METRIC SYSTEM.

A communication from Senator E. F. Ladd requesting a declaration of the opinion of the academy on the adoption of the metric system as provided for in bill S. 2267, introduced by him in the Senate under date of July 18, 1921, was read before the academy, together with the bill, and after discussion the matter was referred to the committee on weights, measures, and coinage, with power to act through the president of the academy.

The text of the bill is as follows:

A BILL To fix the metric system of weights and measures as the single standard of weights and measure for certain uses.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That from and after ten years from the date of passage and

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approval of this act the weights and measures of the meter-liter-gram or metric system shall be the single standard of weights and measures in the United States of America for the uses set out herein.

SEC. 2. That the national prototypes of the fundamental standards of the metric system shall be the copies of the standards known as meter numbered twenty-seven and kilogram numbered twenty, allotted to the United States by the general conference of weights and measures held at Paris in 1889. These are now deposited in the vault of the Bureau of Standards of the Department of Commerce and are those which are now used and employed in deriving the values of all weights and measures used in the United States. These national representations are hereby adopted as the primary standards of weights and measures for the United States of America, and from these all other weights and measures shall be derived and ascertained.

SEC. 3. That from and after ten years from the date of passage and approval of this act no person shall do or offer or attempt to do any of the following acts, by weights or measures, in or according to any other system than the metric system of weights and measures, namely:

(1) Sell any goods, wares, or merchandise except for export, as provided in section 8.

(2) Charge or collect for the carriage or transportation of any goods, wares, or merchandise.

SEC. 4. That from and after ten years from the date of passage of this act no person shall use or attempt to use in any of the transactions detailed in section 3 any weight or measure or weighing or measuring device designed, constructed, marked, or graduated in any other system than the metric system of weights and measures.

SEC. 5. That not later than ten years from the date of passage and approval of this act all postage, excises, duties, and customs charged or collected by weights or measures by the Government of the United States shall be charged or collected in or according to the metric system of weights and measures.

SEC. 6. That rules and regulations for the enforcement of this act not inconsistent with the provisions hereof shall be made and promulgated by the Secretary of Commerce. The Secretary of Commerce shall also take such steps as he may deem expedient for giving publicity to the dates of transition specified herein and for facilitating the transition to the meter-liter-gram or metric system.

SEC. 7. That all acts or parts of acts inconsistent herewith are hereby repealed, but only in so far as they are inconsistent herewith; otherwise they shall remain and continue in full force and effect. Whenever in any act, or rules and regulations, or tariff or schedule made, ratified, approved, or revised by the Government of the United States of America weights or measures of the system now in customary use are employed or referred to, and to comply with the provisions of this act weights and measures of the metric system should be employed, then such references in such act, rules and regulations, tariff, or schedule shall be understood and construed as references to equivalent weights or measures of the metric system ascertained in accordance with the required degree of accuracy.

SEC. 8. That nothing in this act shall be understood or construed as applying to—

(1) Any contract made before the date at which the provisions of this act take effect.

(2) The construction or use of the arts, manufacture, or industry of any specification or drawing, tool, machine, or other appliance or implement designed, constructed, or graduated in any desired system.

(3) Goods, wares, or merchandise intended for sale in any foreign country, but if such goods, wares, or merchandise are eventually sold for domestic use or consumption then this clause shall not exempt them from the application of any of the provisions of this act.

SEC. 9. That nothing herein shall be understood or construed as prohibiting the enactment or enforcement of weights and measures laws or ordinances by the various

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States or cities, and the various States or cities shall have the same powers as though this act were not in force and effect: *Provided, however*, That no standard weights or measures shall be established for the uses set out herein which conflict in any way with the standards established herein, and such standards which may already have been established shall be null and void for the uses set out herein.

SEC. 10. That the word "person" as used in this act shall be construed to import both the plural and singular, as the case demands, and shall include corporations, companies, societies, and associations. When construing and enforcing the provisions of this act, the act, omission, or failure of any officer, agent, or other person acting for or employed by any corporation, company, society, or association, within the scope of his employment or office, shall in every case be also deemed to the act, omission, or failure of such corporation, company, society, or association as well as that of the person.

The home secretary was requested to transmit the thanks of the academy to the president and board of trustees of the University of Chicago, the director of the Yerkes Observatory, the members of the Quadrangle Club, the members of the Chaos Club, and members residing in Chicago serving as a local committee, for courtesies extended to members of the National Academy of Sciences during the autumn meeting.

SCIENTIFIC SESSIONS.

MEETING OF NOVEMBER 14–16, 1921.

The scientific sessions of the academy were held in the Julius Rosenwald Geologic and Geographic Laboratories and Museum, on the campus of the University of Chicago. On Wednesday, November 16, the director and staff of the Yerkes Observatory at Williams Bay, Wis., received members of the academy and their friends.

SCIENTIFIC PAPERS.

MONDAY, NOVEMBER 14.

Raymond Pearl and Sylvia L. Parker: Life tables for drosophila.

Thomas C. Chamberlin: The contrasted types of earth energy and their relative values.

Thomas C. Chamberlin: The paths taken by energy in the self-compression of the earth.

S. W. Parr (introduced by W. A. Noyes): A new theory of the carbonization of coal.

Harvey Fletcher and R. L. Wegel (introduced by J. J. Carty and F. B. Jewett): The frequency-sensitivity characteristic of normal ears.

C. J. Herrick: Some factors in forebrain development.

W. A. Noyes and Walther Goebel: Catalysis of the formation of acetamide by acetic acid.

Mildred Booth and Frank Schlesinger: The parallaxes of 57 stars. (Read by title.)

G. A. Bliss: The transformation of Clebsch in the calculus of variations.

G. A. Miller: Group of isomorphisms of a transitive substitution group.

E. H. Moore: Concerning the reciprocal of a matrix in general analysis.

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William D. Harkins and Anson Hayes: The separation of the isotopes of chlorine.

William D. Harkins and R. S. Mulliken: The separation of the isotopes of mercury.

E. E. Barnard: The dark markings in the Milky Way.

E. W. Washburn and Louis Navias (introduced by W. A. Noyes): A physico-chemical study of flint and chalcedony.

Gerald L. Wendt and Robert S. Landauer (introduced by J. Stieglitz): Further experiments on the ozone form of hydrogen.

W. H. Rodebush (introduced by W. A. Noyes): Entropy of cadmium.

A. A. Michelson: Progress in the application of interference methods at Mount Wilson.

TUESDAY, NOVEMBER 15.

A. J. Carlson: Some physiological actions of saccharin and their bearing on the use of saccharin in foods.

K. K. Koessler and M. T. Hanke (introduced by L. Hektoen): Studies on the proteinogenous amines.

S. B. Hopkins (introduced by W. A. Noyes): Observations on the rare earths.

R. R. Bensley (introduced by C. J. Herrick): The structure of the posterior lobe of the pituitary body.

C. H. Eigenmann (introduced by F. R. Lillie): The nature and origin of the fresh-water fishes of the Pacific slope of South America.

Preston Kyes (introduced by C. J. Herrick): The mechanism of red blood corpuscle destruction.

Julius Stieglitz: Isomeric dimethyl murexides and the theory of color production in organic dyes.

H. I. Schlesinger (introduced by J. Stieglitz): The solubility-product of barium manganate.

C. J. Chamberlain (introduced by J. M. Coulter): Growth rings in the monocots.

J. B. Brown and G. D. Beal (introduced by W. A. Noyes): The highly unsaturated acids of fish oils.

Maud Slye (introduced by L. Hektoen): The influence of heredity on the incidence of cancer.

Edward Kasner: Einstein's cosmological field equations. (Read by title.)

George P. Merrill (introduced by C. D. Walcott): A meteoric iron from Owens Valley, Calif. (Read by title.)

L. E. Dickson: Quaternions in the theory of numbers.

H. B. Lewis (introduced by W. A. Noyes): The intermediary metabolism of cystine.

Lydia M. DeWitt (introduced by L. Hektoen): Studies on the chemotherapy of tuberculosis.

A. B. Coble (introduced by G. A. Miller): The tritangent planes of the normal space sextic of genus four.

A. B. Luckhardt (introduced by A. J. Carlson): On the specificity of gastrin and secretin.

W. D. MacMillan (introduced by E. H. Moore): On certain divergent series.

Henry C. Cowles (introduced by J. M. Coulter): Ecological features of the Red River, a representative braided stream.

L. R. Dragstedt (introduced by A. J. Carlson): On the cause of death from intestinal obstruction.

G. W. Bartelmez (introduced by C. J. Herrick): The neural crest and the primary subdivisions of the neural folds in young human embryos.

Esmond R. Long (introduced by L. Hektoen): Biochemistry of the tubercle bacillus.

George L. Clark (introduced by W. D. Harkins): The properties of salts as related to atomic dimensions.

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ANNUAL MEETING.

The annual meeting of the academy was held at the Smithsonian Institution in Washington, April 24, 25, and 26, 1922.

Eighty-seven members and one foreign associate were present, as follows:

Abbot, C. G.
Ames, J. S.
Bancroft, W. D.
Birkhoff, G. D.
Calkins, G. N.
Carty, John J.
Cattell, J. McK.
Chapman, F. M.
Clarke, F. W.
Clarke, J. M.
Conklin, E. G.
Crew, Henry
Cross, Whitman
Dall, W. H.
Davenport, C. B.
Day, Arthur L.
Dickson, L. E.
Donaldson, H. H.
Duane, William
Dunn, Gano
Fewkes, J. W.
Flexner, Simon
Freeman, J. R.
Gomberg, Moses
Hale, George E.
Hall, Edwin H.
Halsted, W. S.
Harkins, W. D.
Harper, R. A.
Harrison, R. G.
Hayford, John F.
Henderson, L. J.
Hillebrand, W. F.
Holmes, W. H.
Howard, L. O.
Howell, W. H.
Hrdlicka, Ales
Hunt, Reid
Jennings, H. S.
Jewett, F. B.
Jones, L. R.
Kasner, Edward
Kemp, James F.
Lillie, F. R.
Lyman, Theodore
McClung, C. E.
Mark, E. L.
Mendel, L. B.
Mendenhall, C. E.
Mendenhall, T. C.
Merriam, C. H.
Merriam, J. C.
Merritt, Ernest
Miller, D. C.
Millikan, R. A.
Morgan, T. H.
Morse, E. S.
Moulton, F. R.
Nichols, E. L.
Noyes, Arthur A.
Osborn, H. F.
Osterhout, W. J. V.
Pearl, Raymond
Pupin, Michael I.
Ransome, F. L.
Robinson, B. L.
Scott, William B.
Smith, Erwin F.
Squier, George O.
Stebbins, Joel
Stieglitz, Julius
Stratton, S. W.
Taylor, D. W.
Trowbridge, Augustus
Ulrich, E. O.
Van Vleck, E. B.
Vaughan, T. W.
Vaughan, V. C.
Veblen, Oswald
Walcott, C. D.
Welch, Wm. H.
Wheeler, W. M.
White, David
White, H. S.
Wilson, E. B.
Wood, Robert W.
Woodward, R. S.
Lorentz, H. A.[1]

BUSINESS SESSIONS.

The annual report of the president, containing that of the treasurer for the year 1921, in printed form, was presented, accepted, and distributed to members.

The president announced the following:

The death of John Casper Branner, March 1, 1922, his biography assigned to Bailey Willis.

The biography of E. B. Rosa was reassigned to S. W. Stratton.

Announcement was made of—

The following appointments:

[1] Foreign associate.

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Trust fund committees.

Fund.	Appointed.	To succeed.	Term expiring.
Bache	R. G. Harrison	Chairman	
	H. D. Curtis	E. B. Frost	
Smith	Whitman Cross	Himself	1927
Draper	A. A. Michelson	Himself	1927
Comstock	Henry Crew	A. G. Webster	1927
Hartley	S. W. Stratton	Chairman	1925
	S. W. Stratton	Himself	1925
	J. R. Angell	A. A. Noyes	1925
Marsh	J. C. Merriam	Himself	1925
Murray	W. M. Davis	Himself	1925
Thompson	J. M. Clarke	Himself	1925
Science Service	J. C. Merriam	Himself	1924

The election of the following as chairmen of the sections:

Mathematics—Oswald Veblen.
Botany—Liberty H. Bailey.
Zoology and animal morphology—Ross G. Harrison.
Physiology and pathology—Graham Lusk.

The appointment of the following delegates:

University of Southern California, to the inauguration of Rufus Bernhard von KleinSmid as president, April 24 to 26, Walter S. Adams.

International Astronomical Union, to the sessions at Rome, beginning May 2, 1922: R. G. Aitken, L. A. Bauer, Wm. Bowie, H. D. Curtis, Edward Kasner, O. J. Lee, Frank B. Littell, W. F. Meggers, John A. Miller, H. N. Russell, C. E. St. John, Frank Schlesinger (chairman), F. H. Seares, Harlow Shapley, Joel Stebbins.

International Union of Geodesy and Geophysics, to the sessions at Rome, beginning May 2, 1922: L. A. Bauer, Wm. Bowie, H. H. Kimball, G. W. Littlehales, R. A. Millikan, H. Fielding Reid, Frank Schlesinger, H. S. Washington.

University of Padua, to the seventh centenary celebration, May 14 to 17, 1922: H. D. Curtis and F. H. Seares.

American Academy of Political and Social Science, to its meeting at Philadelphia, May 12 and 13, 1922: E. G. Conklin, H. H. Donaldson, C. E. McClung.

International Research Council, to the meeting at Brussels beginning July 18, 1922: George E. Hale and R. A. Millikan.

TRUST FUND RECEIPTS.

The receipt was announced of a third payment on the legacy left to the academy by Mrs. Mary Anna Plamer Draper, amounting to $2,500, bringing the capital of the Billings fund up to $21,750.

The entire capital of the Joseph Henry Fund, amounting to $39,547.04, it was announced, has now been paid in to the academy by the Pennsylvania Co. for Insurances on Lives and Granting Annuities. By the addition of interest to the principal during the coming fiscal year, the capital will be brought up to the sum of $40,000, as originally intended.

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REPORT OF THE COMMITTEE ON WEIGHTS, MEASURES, AND COINAGE.

The president reported that, in accordance with the resolution of the academy passed at the autumn meeting, he had forwarded to Senator Ladd the report of the Committee on Weights, Measures, and Coinage on the Ladd bill,[1] approving the bill with the following statement:

Any measure that might be passed is practically certain to need modifications and amendments before the end of the probationary period.

REPORT OF THE TREASURER.

A statement of assets and liabilities as of December 31, 1921, was read, it being understood that a report for the entire fiscal year July 1, 1921, to June 30, 1922, was to appear in the forthcoming report of the president to Congress.

REPORT OF THE HOME SECRETARY.

The home secretary presented the following report, which was accepted:

The PRESIDENT OF THE NATIONAL ACADEMY OF SCIENCES.

SIR: I have the honor to present the following report of the publications and membership of the National Academy of Sciences for the year ending April 24, 1922.

Of the Memoirs of the Academy, volume 15 has been completed in three parts forming one volume of Psychological Examining in the United States Army, edited by Robert M. Yerkes. The demand for this publication has so far exceeded the supply that an additional 1,000 copies were printed, to be sold at $1.75 each by the Superintendent of Documents. The distribution to members and colleges has been made.

Volume 16 has been completed in three parts, as follows: First memoir, Lower California and its Natural Resources, by Edward W. Nelson; second memoir, Life Cycles of the Bacteria, by F. Löhnis; third memoir, A Recalculation of the Atomic Weights, by Frank Wigglesworth Clarke. All of these have been distributed as separates and the completed volume is now being bound and is expected to be issued within a short time.

Volume 17 will be devoted to the biographical memoirs, continuing a series of which volumes 1 to 9 have been issued in octavo form at the expense of the academy. In the future all biographical memoirs will be issued in quarto form as part of the series of scientific memoirs. The following biographies are now in press: Simon Newcomb, biography by W. W. Campbell, bibliography by R. C. Archibald; Richmond Mayo Smith, by Edwin R. A. Seligman; Samuel Hubbard Scudder, by Alfred G. Mayor; George Jarvis Brush, by Edward S. Dana; Samuel Wendell Williston, by Richard S. Lull; and Charles Van Hise, by T. C. Chamberlin.

Volume 18, The Report of the Committee on the Panama Canal Slides, edited by Whitman Cross, to be complete in one volume, is now in the hands of the Public Printer. The illustrations have been approved and proof of the text is expected within a few days.

Two parts of volume 19 are now with the printer: The Tectonic Conditions Accompanying the Intrusion of Basic and Ultrabasic Rocks, by W. N. Benson, first memoir The Parallaxes of Fifty-seven Stars, by Mildred Booth and Frank Schlesinger, second memoir.

[1] Senate bill, S. 2267.

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Manuscripts for the biographical memoirs of Benjamin Apthorp Gould, by George C. Comstock, that of Henry Pickering Bowditch, by W. B. Cannon, to be published as part of volume 17, are in the hands of the home secretary.

Since the last annual meeting I have to report the deaths of Edward Bennett Rosa, elected 1913, died May 17, 1921; Joel Asaph Allen, elected 1876, died August 29, 1921; Henry Prentiss Armsby, elected 1920, died October 19, 1921; John Casper Branner, elected 1905, died March 1, 1922; and of two foreign associates, Wilhelm Waldeyer, elected 1909, and Marie Ennemond Camille Jordan, elected 1920.

The present active membership of the academy is 198 members and 36 foreign associates.

C. G. ABBOT, *Home Secretary.*

AMENDMENT TO CONSTITUTION.

The following amendment to the constitution, recommended by the executive committee of the Proceedings, was approved by the committee of the whole:

Article 5, section 3 of the constitution of the National Academy contains the following paragraph:

The Proceedings shall include the transactions of the academy, brief original announcements of the results of scientific investigations made by members of the academy or others, together with short original articles giving a comprehensive survey of the more important scientific researches currently made by American investigators and other matters of general scientific interest.

It is proposed that this paragraph shall be replaced by the following:

The Proceedings shall be primarily a medium of first publication for original articles in brief form of permanent scientific value.

AMENDMENT TO RULES.

Upon the recommendation of the executive committee of the Proceedings, the second, fourth, fifth, sixth, and seventh paragraphs of Rule V:1 were repealed.

RESEARCH FUNDS.

BACHE FUND.

Since the last annual meeting the following grants have been made:

229. H. Nort, Gouda, Holland, $200. For counting the stars on the Franklin Adams charts.

230. H. S. Jennings, Johns Hopkins University, Baltimore, $300. To study the cytology of the rhizopod difflugia.

231. Herbert M. Evans, University of California, Berkeley, Calif., $500. To determine the oestrus cycle by means of histological changes in the vaginal and uterine fluid in other mammals than the rat (rabbit and cat especially).

232. Carl G. Hartman, University of Texas, Austin, $500. To complete observations on the oestrus cycle of the opossum.

233. William Bowie, Washington, D. C., $250. Observations at the Ukiah latitude station. This grant has been canceled at the request of Doctor Bowie because of Government appropriations to carry on the work.

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Reports of previous grants have been received as follows:

193. Charles A. Kofoid, University of California. Two papers on the parasitic protozoa of the stomach of ruminants, in preparation. Research nearing completion.

211. G. H. Shull, Princeton University. Grant used for part payment of salary of garden attendant. Genetical studies on œnothera and Shepherd's purse are being continued extensively, especially with linkage in the former and duplication of factors and sterility in the latter. Preliminary reports in press.

213. Duncan S. Johnson, Johns Hopkins University. Work on three species, well along. Results not yet published.

214. Carl H. Eigenmann, University of Indiana. Research completed. Published in Memoirs of the Museum of Comparative Zoology, Harvard, vol. 43, parts 1 and 2. Research continued under grant No. 220.

215. H. W. Norris, Grinnell College. Preliminary paper will be published in Proceedings of Iowa Academy of Science, 1922; work on cranial nerves of amia and lepidosteus nearing completion, but the final publication will be included in the report on the ganoids in general.

216. A. A. Schaeffer, Knoxville, Tenn. Research in progress, but delayed by difficulty in obtaining space for experiments. Preliminary report in preparation for publication.

217. H. Nort, Gouda, Holland. Star counts have been made for some more charts of the southern hemisphere; additional counts have been made to find distance correction for the Franklin Adams charts; formulæ have been derived to compute the equatorial coördinates of the fields counted from the declination and the R. A. of the center of the plate and the focal length of the telescope used; the limiting magnitude for 10 additional charts of the northern hemisphere has been derived.

218. J. C. Jensen, University Place, Nebraska. Preliminary results published in Proceedings of Nebraska Academy of Science, 1919. Considerable progress has been made, but delayed by difficulty in apparatus.

219. H. G. Barbour, McGill University, Montreal. Research concluded. Preliminary publication: Proc. Soc. for Exp. Biol. & Med. 1920, XVII, 148–154 and 209–210. Final publication: 1. Journ. Pharm. and Exper. Therap. 1921, XVIII, 165–183. 2. Amer. Journ. Physiol. 1921, LVII, 387–394, 3 and 4. Full reports of the investigations in which Doctors Howard and Baretz collaborated are now ready for publication.

220. Carl H. Eigenmann, University of Indiana (supplementing 214). Results published in Proc. Am. Philos. Soc., Washington Acad. Sci., Indiana University Studies. Research on fishes of upper Amazon basin and fishes of Lake Titicaca in progress.

221. William Bowie, United States Coast and Geodetic Survey. Results published in Proceedings. Reduced Geodetic Association or in Proceedings of Section of Geodesy of the International Geodetic and Geophysical Union. Observations will continue indefinitely.

222. C. H. Warren, Massachusetts Institute of Technology. Paper on "The pegmatites associated with the alkalic granites of Cape Ann, Mass.," ready for publication. Paper on the granitic rocks of Cape Ann well advanced toward publication. Work on a paper dealing with the labradorite porphyries of Essex County, Mass., nearly ready. Work on the mixed granite-porphyry dikes of Briar Neck, Gloucester, Mass., complete; paper to be written this summer.

223. W. Lindgren, Massachusetts Institute of Technology. Chemical work completed. Calculation of analyses and full report will be ready December 1, 1922.

224. T. H. Goodspeed, University of California. Preliminary results published in volume 5, University of California, Publications in Botany. The apparatus purchased with this grant will be used continuously for the illustration of the experiments for an indefinite period.

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225. L. B. Mendel and F. P. Underhill, Yale University. Research is in progress and results are quite satisfactory, but not ready for publication.

226. Gilbert N. Lewis, University of California. Number of men are engaged in calculations and checks of the table of free energies which is to be published in a book by Professors Randall and Lewis. Book in in the hands of the publishers.

227. H. W. Norris, Grinnell College. Research in progress. A preliminary report to be published in the 1922 Proceedings Iowa Academy of Sciences. A large amount of material has been collected, but work is delayed by inability to secure an assistant.

228. Preston Edwards, University of Texas. Apparatus has been designed and constructed and some preliminary observations made.

Following the resignation of Prof. E. B. Frost as member and chairman of the Bache fund directors, Prof. Ross G. Harrison was made chairman of the board and Dr. Heber D. Curtis, of the Allegheny Observatory, was elected to fill the vacancy in membership.

The board has voted to consider applications for grants in April and October of each year.

The treasurer of the academy reports that on March 30 there was an unexpended balance of $874.71. Awards which will be made this month will exhaust this and the income of the fund until about September 30 of the present year.

ROSS G. HARRISON,
Chairman Board of Directors of the Bache Fund.

Report received.

WATSON FUND.

The Watson trustees have been advised by Dr. William Bowie, chief Division of Geodesy, United States Coast and Geodetic Survey, that the grant of $500 made from the Watson fund at the fall meeting of the academy for the maintenance of the International Latitude Observatory at Ukiah, can be repaid in full to the academy, in view of the fact that the Congress has appropriated $2,000 for the support of the observatory for the current year.

As Doctor Bowie, the Watson trustees, Doctor Campbell, and other astronomers with whom we have conferred agree that the compensation of the observer has been entirely inadequate and subject to long delays, involving considerable hardship, the Watson trustees recommend that Doctor Bowie be authorized to retain $200 of the sum of $500 granted to him, with the understanding that this sum of $200 be applied to increase the salary of the observer from July 1, 1921, to June 30, 1922.

THE WATSON TRUSTEES.
A. O. LEUSCHNER, *Chairman.*
GEORGE C. COMSTOCK.
WILLIAM L. ELKIN.

Report received and recommendation approved.

DRAPER FUND.

The Henry Draper committee has unanimously recommended that the Draper gold medal for the year 1922 be awarded to Dr. Henry Norris Russell, professor of astronomy and director of the observatory in Princeton University, chiefly in recognition of the remarkably valuable contributions which he has made to our knowledge of the order of stellar evolution and of the underlying causes therefor.

The committee unanimously recommends that the formal presentation of the medal to Professor Russell be delayed until the meeting of the academy to be held in the fall of 1922, on which occasion it is expected that the recipient can be present.

The committee recommends that a grant of $375 be made to Dr. E. A. Fath, professor of astronomy in Carleton College, Northfield, Minn., for the purchase of a string

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electrometer in partial equipment of a photoelectric cell photometer for application to the photometry of the stars.

The financial condition of the Henry Draper fund on March 30, 1922, was as follows:

Invested capital	$10,000.00
Invested income	917.50
Income	1,084.08

The sum available for the promotion of research was therefore $2,001.58.

Respectfully submitted.

W. W. CAMPBELL, *Chairman.*

April 14, 1922.

Report received and recommendation approved.

The other members of the committee unanimously recommend a grant of $450 to W. W. Campbell for eclipse apparatus.

C. G. ABBOT.
GEORGE E. HALE.
A. A. MICHELSON.
H. N. RUSSELL.

Recommendation approved.

J. LAWRENCE SMITH FUND.

Medal.—At the November meeting, 1921, the academy approved a recommendation of this committee that the J. Lawrence Smith medal be awarded to Dr. George Perkins Merrill, head curator of the department of geology and paleontology of the United States National Museum, for his important contributions to knowledge concerning meteorites.

Grant 11.—At its November meeting, the academy approved a grant of $500 to Dr. George P. Merrill in aid of further investigations of the character of meteorites. Work under the grant is now in progress.

Publication.—There was issued in 1921 a publication of the Leander McCormick Observatory of the University of Virginia entitled "349 parabolic orbits of meteor streams and other results," by Charles P. Olivier. This is a discussion of 22,000 observations of meteors made by members of the American Meteor Society. It is a comprehensive report of results of an investigation which has been aided by several grants from the J. Lawrence Smith fund made at various times since 1915 to Prof. S. A. Mitchell, director of the McCormick Observatory, under whose supervision the work has been done.

At the April meeting of 1921 the academy approved the expenditure of not more than $300 to defray the expenses of editing and publishing four papers by Mabel Weil, presenting results of investigations by the late C. C. Trowbridge of meteor trains, which have been supported by grants from the J. Lawrence Smith fund, the editing of these papers to be in the hands of Dr. Frank Schlesinger. Some progress has been made during the year.

Financial statement.—The treasurer of the academy reports as follows concerning the J. Lawrence Smith fund as of March 30, 1922:

Invested capital	$10,000.00
Invested income	2,542.50
Uninvested income	1,529.49
Liabilities:	
Grant to G. P. Merrill	490.00
Editing and publishing Trowbridge manuscripts	300.00
Expense of medal (estimated)	210.00

No application for a grant is now before the committee.

WHITMAN CROSS, *Chairman.*

Report received.

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WOLCOTT GIBBS FUND.

The directors report that during the current year ending April 1, 1922, no applications for grants have been received and no further grants authorized.

They report also that, to their very great regret, Prof. Charles Loring Jackson has found it impossible to continue his work as chairman of the board and has therefore resigned. The directors desire to put on record their high appreciation of the devoted services which he has rendered to the academy, and to this board as its chairman, since the foundation of the fund 30 years ago, and to express their deep regret that he should be obliged to resign from the board. His successor has not yet been appointed.

According to the report of the treasurer and bursar of the National Academy, the condition of the fund on March 30, 1922 was as follows:

Uninvested cash income	$277.87
Invested income	500.00
Invested capital	5,545.50

T. W. RICHARDS.
EDGAR F. SMITH.

Report received.

COMSTOCK FUND.

As chairman of the committee in charge of the Comstock fund I beg to report as follows:

(1) That since the previous award of the Comstock prize was made to Samuel Jackson Barnett in April, 1918, the next forthcoming award will be due in 1923, at which time the committee hopes to make suitable recommendations.

(2) That the treasurer of the academy states the available income from the fund to be $2,227.30.

For the committee.

EDWARD L. NICHOLS, *Chairman.*

Report received.

MURRAY FUND.

We are informed by the treasurer that the condition of the fund at present is as follows:

Invested capital	$6,000.00
Invested income	400.00
Uninvested income	1,036.77
	7,436.77

Owing to world conditions and the cessation during several years past of active oceanographic work, the committee is unable to advise that the medal be awarded this year, no conspicuous evidence of progress in oceanography being reported at present.

Very respectfully,

WM. H. DALL,
Chairman of the Committee.

Report received.

ELLIOT FUND.

The committee has unanimously voted the medal and honorarium for 1920 to Othenio Abel for his inspiring work, entitled "Methoden der paläobiologischen forschung."

HENRY FAIRFIELD OSBORN, *Chairman.*

Report received and recommendation approved.

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MARY CLARK THOMPSON FUND.

Because of inadequate income, no award can be made of the Thompson medal this year.

JOHN M. CLARKE, *Chairman.*

Report received.

MARSH FUND.

Permit me to report for the Marsh fund committee the following grants which were read before the meeting of the academy on April 24 and approved by vote of the academy:

1. One hundred and fifty dollars to Dr. Carl O. Dunbar of Yale University for collection and study of Permian insects.

2. Seventy-five dollars to Miss Winifred Goldring of the State museum, Albany, N. Y. for investigation of the Devonian plants of Gaspe.

3. Three hundred dollars to Dr. W. J. Sinclair, of the department of geology of Princeton University, for continuation of his studies on the stratigraphic sucession of mammalian faunas of the White River Oligocene.

4. Two hundred dollars to Dr. Rudolf Ruedemann of the State museum, Albany, N. Y., for studies on the graptolites of North America.

5. One hundred and fifty dollars to Dr. F. Canu and Dr. R. S. Bassler, of the United States National Museum, for continuation of monographic studies on recent and fossil bryozoa.

6. Three hundred dollars to Dr. C. W. Gilmore, of the United States National Museum, for continued work on a monographic study of the fossil lizards of North America.

The grants approved by the academy total a sum of $1,175, there being available to the committee for this year the sum of $1,177.16.

J. C. MERRIAM, *Chairman.*

Report received and recommendations approved.

WASHINGTON, D. C., *May 5, 1922.*

DR. C. G. ABBOT,
Home Secretary, National Academy of Sciences,
Smithsonian Institution, Washington, D. C.

MY DEAR DOCTOR ABBOT: In consideration of the policy of the Marsh fund committee relative to recommendation of grants, the committee unanimously approved the application of two principles for determination of its action in the future. I do not believe that these principles should be considered as rigid rules, but they are accepted as governing the action of the Marsh fund committee wherever possible. These definitions of policy are, first, to the effect that the committee requests of grantees under the Marsh fund, a report at the end of the year for which a grant is made, with the understanding that such report should give in general the progress made in the investigation, the statement being in such form that it may be filed as part of the record of the Marsh fund committee.

The second principle is in effect that extensions of grants for investigations supported by the academy through the Marsh fund may, in certain instances, be made for important work requiring continuous effort over a period longer than one year. It is, however, understood that, in general, such extension of grants will not be carried over a period longer than three years, and it is further understood that extension of grants beyond one year will not be considered unless satisfactory reports of advance in work are made before consideration is given to the question of continuation of the grant.

In making the report of the Marsh fund committee to the academy these principles were stated, but it is not my understanding that they were voted upon by the academy.

With best wishes, I am,

Very sincerely yours,

JOHN C. MERRIAM.

Approved.

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GOULD FUND.

During the year the directors of the Gould fund have made two grants, one of $1,000 to Prof. Benjamin Boss for the support of the Astronomical Journal, and one of $150 to Dr. William Bowie for the support of the International Latitude Observatory, Ukiah, Calif.

The status of the Gould fund is as follows:

Invested capital	$19,822.50
Invested income	7,010.00
Total investments	26,832.50
Uninvested capital	177.50
Uninvested cash income	2,065.68
Total uninvested capital and income	2,243.18

F. R. MOULTON,
ROBERT S. WOODWARD,
Directors.

Report received.

JOSEPH HENRY FUND.

Acting for Dr. W. F. Durand, chairman of the Joseph Henry fund, permit me to report the following grants recommended to the National Academy:

1. The sum of $1,000 to Prof. Carl T. Compton, of the Palmer physical laboratory, Princeton, N. J., for researches on the electric moments of molecules.

2. The sum of $250 to Dr. H. J. Muller, of the University of Texas, for the purchase of a microscope especially designed for selective illumination of given cells or portions of cells by means of visible or ultraviolet light for use in studies in cytology, embryology, and genetics.

3. The sum of $500 to Dr. Ales Hrdlicka, of the United States National Museum, for support of investigations relating to the origin and antiquity of man on the American and Asiatic continents.

The total of the grants approved amounts to $1,750, there being available to the committee this year a total of $2,275.67. It is expected that consideration will be given to further grants from this fund after the return of Dr. W. F. Durand, and before the fall meeting of the academy.

J. C. MERRIAM, *Acting Chairman.*

Report received and recommendations approved.

RECOMMENDATIONS FROM THE COUNCIL.

The following recommendations from the council were adopted:

That the annual dues for the fiscal year July 1, 1922, to June 30, 1923, be $10, of which $5 shall be for the general fund and $5 for the Proceedings.

That the election of new members, and of the foreign secretary and two members of the council, be held Wednesday morning, April 26, 1922.

That the American Security & Trust Co., of Washington, D. C., and Spencer, Trask & Co., of New York, be designated fiscal advisers of the academy for the year 1922–23.

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That the invitation of the New York members to hold the autumn meeting of 1922 in that city be accepted, and that the time be left to the president and home secretary with power.

That in view of the absence of Henry Norris Russell as a delegate of the academy to the meetings in Rome of the International Astronomical Union, the presentation to him of the Henry Draper medal, which has been awarded to him, be deferred until the autumn meeting.

That the following resignation of E. W. Morley as member of the Committee on Coinage, Weights, and Measures be accepted with regret and that the home secretary be directed to express to him the appreciation of the academy for his long and faithful service:

8 WESTLAND AVENUE, WEST HARTFORD, CONN.

DR. T. C. MENDENHALL,
Chairman Committee on Weights, Measures, and Coinage,
National Academy of Sciences.

SIR: Since I am not likely to be able to attend meetings of the academy or of this committee, I hereby resign from membership in the committee.

Your obedient servant,

EDWARD W. MORLEY.

MARCH 30, 1922.

That the following resignation of C. L. Jackson as chairman and member accepted by the Committee on the Wolcott Gibbs Fund be received with regret and that the home secretary be directed to express to him the appreciation of the academy for his long and faithful service:

To the Directors of the Wolcott Gibbs Fund for Chemical Research.

GENTLEMEN: It is with great regret that I find myself obliged to resign my position as a member of your board, because I am no longer able to perform the duties connected with it.

Very respectfully,

CHARLES LORING JACKSON.

March 21, 1922.

SECTIONAL ORGANIZATION AND PERSONNEL.

The following resolution, presented by Henry Fairfield Osborn, was referred to the committee on nominations:

Whereas there are important omissions in the academy membership of men of international distinction: Be it therefore

Resolved, That the academy reconsider its present sectional organization and personnel.

ELECTIONS.

R. A. Millikan was reelected foreign secretary for the term expiring in 1926.

Messrs. Joseph S. Ames and Gano Dunn were elected members of the Council, their terms expiring in 1925, in succession to Messrs. John J. Carty and H. H. Donaldson.

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Albert Einstein, of the University of Berlin, was elected a foreign associate.

The following were elected to membership:

Berry, Edward Wilber, Johns Hopkins University, Baltimore, Md.
Burgess, George Kimball, Bureau of Standards, Washington, D. C.
Cole, Rufus, Rockefeller Hospital, New York, N. Y.
Eisenhart, Luther Pfahler, Princeton University, Princeton, N. J.
Erlanger, Joseph, Washington University, St. Louis, Mo.
Hoover, Herbert, Secretary of Commerce, Washington, D. C.
Hulett, George Augustus, Princeton University, Princeton, N. J.
Kofoid, Charles Atwood, University of California, Berkeley, Calif.
Merrill, George Perkins, United States National Museum, Washington, D. C.
Seashore, Carl Emil, State University of Iowa, Iowa City, Iowa.
Stockard, Charles Rupert, Cornell University Medical School, New York, N. Y.
Swasey, Ambrose, 5701 Carnegie Avenue, Cleveland, Ohio.
Wright, William Hammond, Lick Observatory, Mount Hamilton, Calif.

The home secretary was requested to transmit the thanks of the Academy to the Smithsonian Institution and to the Department of Agriculture for courtesies extended to its members during the annual meeting.

SCIENTIFIC SESSIONS.

MEETINGS OF APRIL 24, 25, AND 26, 1922.

MONDAY, APRIL 24.

C. D. Walcott: The new building of the National Academy and National Research Council (illustrated).

D. H. Campbell: Queries concerning the origin of the Australian floras.

L. R. Jones, J. G. Dickson, and J. C. Walker: Inquiries into the nature of disease resistance or immunity in certain plants (illustrated).

L. O. Howard: A side effect from the importation of parasites of injurious insects (illustrated).

E. L. Mark and L. C. Wyman: Mitochondrial bodies in the spermatogenesis of Chorthippus curtipennis (Scudd) (illustrated).

A. F. Blakeslee (introduced by C. B. Davenport): Vegetative types in Datura due to somatic number of chromosomes (illustrated).

W. G. MacCallum and E. H. Oppenhiemer: A method for the study of filterable viruses as applied to vaccinia.

Simon Flexner and H. L. Amoss: Continuation report on experiments in epidemiology (illustrated).

W. S. Halsted: Replantation of entire limbs without suture of blood vessels (illustrated).

H. F. Osborn and C. A. Reeds: Recent discoveries on the antiquity of man (illustrated).

A. Hrdlicka: Stature and head form in Americans of old families.

A. H. Clark (introduced by C. G. Abbot): Animal evolution.

F. M. Chapman: The distribution of the Motmots of the genus Momotus.

A. O. Leuschner: New results on the theory of the minor planets. (10 minutes.)

H. N. Russell: Dark nebulæ.

C. G. Abbot, F. E. Fowle, and L. B. Aldrich: The larger results of 20 years of solar radiation observations (illustrated).

H. A. Lorentz: Problems of modern physics.

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TUESDAY, APRIL 25.

M. T. Bogert: Researches on thiazoles.

M. T. Bogert: Researches on selenium organic compounds.

M. Gomberg: Reaction between silver perchlorate and the halogens.

G. L. Wendt (introduced by W. A. Noyes): The thermal decomposition of tungsten (illustrated).

A. A. Noyes and H. A. Wilson: A confirmation of Saha's theory of the thermal ionization of elements at high temperatures.

W. D. Harkins: The general system of isotopes as related to the formation and disintegration of atom nuclei.

E. H. Hall: A theory of electric conduction in metals.

A. L. Day: Cooperative studies of California earth movements.

W. M. Davis: Geological overthrusts and underdrags.

J. F. Hayford: The effects of winds and barometric pressures on the Great Lakes (illustrated).

H. A. Brouwer (introduced by T. W. Vaughan): Striking similarities between igneous rocks of Brazil and South Africa (illustrated).

J. C. Merriam and Chester Stock: Fauna of the Pleistocene asphalt deposits of McKittrick, Calif. (illustrated).

F. B. Jewett: The telephone engineer a public trustee.

F. B. Jewett: The loud-speaking telephone (apparatus).

R. L. Wegel (introduced by J. J. Carty and F. B. Jewett): The physical examination of hearing and binaural aids for the deaf (apparatus).

Donald MacKenzie (introduced by J. J. Carty and F. B. Jewett): The relative sensitivity of the ear at different levels of loudness (illustrated).

J. S. Ames: Recent progress in aeronautics (illustrated).

R. A. Millikan: The coefficient of slip and the reflection of molecules (illustrated).

R. A. Millikan: The origin of penetrating radiations of the upper air (illustrated).

W. A. Shewhart (introduced by J. J. Carty and F. B. Jewett): On the measurement of a physical quantity whose magnitude is influenced at random by primary causes beyond the control of the observer, and on the method of determining the relation between two such quantities (illustrated).

D. C. Miller: Ether drift experiments at Mount Wilson in 1921 and at Cleveland in 1922 (illustrated).

R. S. Woodward: Some extensions in the mathematics of hydromechanics.

G. D. Birkhoff: Normal coordinates and Einstein space.

Edward Kasner: Algebraic solutions of Einstein's cosmological equations.

Oswald Veblen: The geometry of paths.

F. M. Chapman: Biographical memoir of Dr. J. A. Allen (by title).

G. C. Comstock: Biographical memoir of Benjamin Apthorp Gould (by title).

W. B. Cannon: Biographical memoir of Henry Pickering Bowditch (by title).

Frank Schlesinger: Catalogue of bright stars.

William M. Davis: Biographical memoir of Grove Karl Gilbert (by title).

H. F. Osborn: Biographical memoir of Edward Drinker Cope (by title).

Gustave Stromberg (introduced by G. E. Hale): The distribution of the velocities of stars of late types of spectrum.

W. S. Adams and A. H. Joy: A method of deriving the distance of the A-type stars.

G. E. Gibson and W. F. Giauque (introduced by G. N. Lewis): The entropy of supercooled and crystalline glycerin and the third law of thermodynamics.

D. D. Van Slyke and L. J. Henderson: Physico-chemical equilibria in the blood.

H. F. Osborn: Discovery of an anthropoid ape in western Nebraska, the first found in America.

A. P. Dachnowski (introduced by J. M. Coulter): A correlation of time units and climatic changes in peat deposits of the United States and Europe.

Oswald Veblen: A new form of the differential equations of gravitation.

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PRESENTATION OF MEDALS.

Two medals were presented at the annual dinner, held at the Powhatan Hotel, Tuesday evening, April 25, 1922.

The J. Lawrence Smith medal was awarded to Dr. George Perkins Merrill, curator of geology at the United States National Museum. This is the first award of the J. Lawrence Smith medal since 1888. Dr. Whitman Cross, in stating the reasons for the presentation of the medal, pointed out that Dr. Merrill has continued to carry on the work of his predecessor, J. Lawrence Smith, on meteorites, by the application of modern methods of analysis, and that, at the same time, he has extended the list of elements and compounds that exist in these bodies. Doctor Merrill has also discovered evidences of metamorphism in meteorites, where a mineral structure has been broken up and the fragments later fused together similar to the conglomerates found in igneous rocks in the earth's crust. Doctor Merrill responded with a brief address.

In the presentation of the Daniel Giraud Elliot medal for the year 1921 to Dr. Othenio Abel, of the University of Vienna, Dr. Henry Fairfield Osborn outlined the difficulties under which the inspiring work, "Methoden der palãobiologischen Forschung," was produced by Doctor Abel. The medal was received by Dr. Edgar L. G. Prochnik, the chargé d'affaires of the Austrian Legation, for transmittal to Doctor Abel.

Further addresses were made by Dr. Vernon Kellogg, permanent secretary of the National Research Council; Dr. William H. Welch, past president of the academy; and Dr. Hendrik Anton Lorentz, of the University of Leyden, foreign associate of the academy.

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REPORT OF THE NATIONAL RESEARCH COUNCIL FOR THE YEAR JULY 1, 1921–JUNE 30, 1922.

(Prepared by Vernon Kellogg, permanent secretary, with the assistance of the chairmen of divisions.)

INTRODUCTION.

For the benefit of those who may see for the first time in this annual report any statement concerning the organization and activities of the National Research Council, I reproduce here, with few changes, certain paragraphs first printed in the annual report of the council for the year 1920. These paragraphs relate to the general organization and methods of the council.

The National Research Council is a cooperative organization of the scientific men of America, including also a representation of men of affairs and business men interested in industry and engineering and in the fundamental or "pure" science on which the "applied" science used in these activities depends. The council enjoys the formal recognition and active cooperation of most of the major scientific and technical societies of the country, its membership being composed in large part of appointed representatives of these societies. Its essential purpose is the promotion of research in the physical and biological sciences and the encouragement of the application and dissemination of scientific knowledge for the benefit of the Nation.

The council is composed of a series of major divisions, one group of seven divisions of science and technology representing, respectively, physics, mathematics and astronomy; chemistry and chemical technology; anthropology and psychology; geology and geography; biology and agriculture; the medical sciences; and engineering; and another group of six divisions of general relations, representing foreign relations, Federal relations, States relations, educational relations, research extension, and research information. As subordinate or affiliated lesser groups, each of these divisions comprises a larger or smaller series of committees, each with its special problem or subject of attention. There are certain other committees, administrative and technical, which affiliate directly with the executive board of the council. Its general administrative officers are a chairman, three vice chairmen, permanent secretary, treasurer, and a chairman of each of the various divisions. All of these, except the permanent secretary and treasurer, are elected annually by the executive board or by the members of the divisions.

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The council is neither a large operating scientific laboratory nor a repository of large funds to be given away to scattered scientific workers or institutions. It is rather an organization which while clearly recognizing the unique value of individual work, hopes especially to help bring together scattered work and workers and to assist in coordinating in some measure scientific attack in America on large problems in any and all lines of scientific activity, especially, perhaps, on those problems which depend for successful solution on the cooperation of several or many workers and laboratories, either within the realms of a single science or representing different realms in which various parts of a single problem may lie. It particularly intends not to duplicate or in the slightest degree to interfere with work already under way; to such work it only hopes to offer encouragement and support where needed and possible to be given. It hopes to help maintain the morale of devoted isolated investigators and to stimulate renewed effort among groups willing but halted by obstacles. It will try to encourage the interest of universities and colleges in research work and the training of research workers, so that the inspiration and fitting of American youth for scientific work may never fall so low as to threaten to interrupt the constantly needed output of well-trained and devoted scientific talent in the land. With any serious interruption in the output of American science and scientific workers, the strength of the Nation will be immediately threatened.

The methods of contributing practical assistance to American science in harmony with the general point of view and policy outlined above which the council has so far adopted are various. One is the establishment of special committees of carefully chosen experts for specific scientific subjects or problems urgently needing consideration, which plan modes of attack and undertake to find men and means (with the assistance of the general administrative offices of the council) for carrying out the plan. Another is the bringing together of industrial concerns interested in the development of the scientific basis of their processes and inducing them to support the establishment of special scientific investigations under the advice of experts representing the council. Another is the stimulation of larger industrial organizations, which may be in the situation to maintain their own independent laboratories, to see the advantage of contributing to the support of pure science in the universities and research institutes for the sake of increasing scientific knowledge and scientific personnel on which future progress in applied science absolutely depends. Other methods are the direct maintenance of university research fellowship; the publication of valuable scientific papers for which there is at present no other suitable prompt means of issuance; the preparation of bibliographies and abstracts of current scientific literature; the setting up of well-considered mechanisms

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for the collection and distribution of information on current research, university and industrial research laboratories and facilities, research personnel, etc.; and the dissemination through the press and magazines of popular but authentic scientific news and information for the sake of increasing the public interest in and support of productive scientific work. Still other forms of activities might be listed, but those given adequately illustrate the council's methods.

RELATIONS TO THE NATIONAL ACADEMY OF SCIENCES.

The National Research Council was established in 1916 at the request of the President of the United States under the charter of the National Academy of Sciences. The existence of the council and its work was specially recognized by the President by an Executive order dated May 11, 1918, in which its institution by the Academy under its congressional charter was referred to, and the academy was requested by this order to perpetuate the council for the doing of certain duties specified in the order. In an opinion rendered by the Attorney General of the United States on January 29, 1920, the National Research Council was recognized as a special agency of the National Academy of Sciences for the accomplishment of certain particular purposes.

The funds derived by gift or otherwise for the use of the council are held by the academy and are paid out only on general or specific authorization of the academy. The treasurer of the academy is ex officio treasurer of the council and all checks made out by the bursar of the council are signed by an official of the academy and one of the council. The council participates on equal terms with the academy in the support and use of the Proceedings of the academy.

But the council has its own officers and membership and determines, under the general provisions of its founding by the academy, its own policies and activities.

RELATIONS TO THE ENGINEERING FOUNDATION.

The Engineering Foundation, established in 1914 by United Engineering Society, acting for the National Societies of Civil, Mining and Metallurgical, Mechanical, and Electrical Engineers, continues its intimate relations with the division of engineering, and is represented on the executive board. The Foundation contributes funds for the division of engineering and provides it with an office in Engineering Societies Building, 29 West Thirty-ninth Street, New York. In September, 1921, Engineering Foundation completed payment of its $30,000 grant for research in fatigue phenomena of metals. Since that time it has continued to act as treasurer for the equal fund being contributed by the General Electric Co. and to cooperate in other ways in the continuance of this research. Engi-

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neering Foundation has cooperated with the division in other projects also and from time to time seeks advice from the division's consulting committees on projects of its own. The secretary of the foundation is chairman of the division of engineering.

FINANCIAL SUPPORT.

The major support for the general maintenance expenses of the National Research Council during the past year has come from the Carnegie Corporation of New York. The Corporation in March, 1919, expressed its readiness to appropriate $5,000,000 for the erection of a building for the joint use of the council and the National Academy of Sciences, and for an endowment for the council, provided a suitable site in Washington should be obtained from other sources and a satisfactory plan for the building should be presented.

A suitable site was obtained and the building is now in process of construction (see later paragraph on "New building"). In the meantime the corporation appropriated $185,000 for current expenses for the year July 1, 1921, to June 30, 1922.

The Rockefeller Foundation has during the year pledged itself to make two new considerable appropriations to the council for special purposes. One is the sum of $250,000, payable in amounts not to exceed $50,000 a year for five years, for the maintenance of advanced fellowships in medicine. A similar sum under similar conditions has been pledged by the General Education Board. This sum of $500,000, added to the $500,000 previously appropriated by the foundation for the maintenance through a five-year period of research fellowships in physics and chemistry, makes a total of $1,000,000 available to the council for fellowships. The other is the sum of $85,000 for the cleaning up of certain outstanding obligations of the Concilium Bibliographicum, an international institution for scientific bibliography, and for assisting in the maintenance of this institution for five years. The following amounts on these accounts and certain others have actually been received from the foundation by the council during the year: For research fellowships in physics and chemistry, $75,208.32; for fellowships in medicine, $231.85; for Concilium Bibliographicum, $30,000; for the division of physical sciences, $6,679.17.

From the General Education Board (already mentioned as having pledged $250,000 at the rate of $50,000 a year for five years for fellowships in medicine) have been received: For the division of educational relations, $2,500; for fellowships in medicine, $231.84.

From the Chemical Foundation: For special work on chemistry by the research information service, $7,500; for work on the standardization of biological stains, $500.

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From various organizations, chiefly railroads, for the investigation of injuries to marine piling, $15,797.

From various organizations for the advisory board on highway research, $14,000.

From various organizations for the trustees for the publication of physical and chemical constants, $13,736.73.

Other contributions include: The sum of $2,000 from Julius Rosenwald toward the support of a fellowship in biology; from the Corning Glass Works toward the support of a fellowship in ceramics, $1,000; from the Southern Pine Association, for the use of the committee on forestry, $3,000; from various organizations, for the use of the food and nutrition committee, $1,350; from Glass Container Association of America, for an investigation of food products, $568.28; from various individuals, for international language, $950; from Theodore Lyman, special contribution toward the publication of Kayser's handbook on spectroscopy, $500; from various sources, for the committee on substitute deoxidizers, $400; for the use of the committee on atmosphere and man, $1,000; for expenses of chemical exhibits, $8,317.40; for motion-picture films, chemical exhibits, $1,500; for conference on sex research, $1,000; for national intelligence tests, $1,602.07.

NEW BUILDING.

In conformity with the provision made in connection with the appropriation by the Carnegie Corporation of New York, for the erection of a building for the joint use of the National Academy of Sciences and the National Research Council, a desirable site in Washington was obtained for approximately $185,000 by the generous gifts of the following donors: Thomas D. Jones, Harold F. McCormick, Julius Rosenwald, and Charles H. Swift, Chicago; Charles F. Brush, George W. Crile, John L. Severance, and Ambrose Swasey, Cleveland; Edward Dean Adams, Mrs. E. H. Harriman, and the Commonwealth Fund, New York City; George Eastman and Adolph Lomb, Rochester; E. A. Deeds and Charles F. Kettering, Dayton; Henry Ford, Detroit; Arthur H. Fleming, Pasadena; A. W. Mellon, Pittsburgh; Pierre S. du Pont, Wilmington; Raphael Pumpelly, Newport; Mr. and Mrs. H. E. Huntington, Los Angeles; Corning Glass Works, Corning, N. Y.

This site is the entire block between Twenty-first and Twenty-second and B and C Streets, almost directly opposite the Lincoln Memorial.

The building is now under construction and should be ready for occupancy in October, 1923. The architect is Mr. Bertram G. Goodhue, of New York City, and the general contractors are the C. T. Wills Co. (Inc.), of New York City. The Academy and Council

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are confident that the new building will be of great architectural interest and beauty and admirably fitted for practical use.

OFFICERS FOR 1922–23.

At the meeting of the executive board on April 23, 1922, the following officers were elected for the year July 1, 1922, to June 30, 1923: Chairman of the executive board, John C. Merriam, president, Carnegie Institution of Washington; first vice chairman, Charles D. Walcott, secretary, Smithsonian Institution and president, National Academy of Sciences; second vice chairman, Gano Dunn, president of J. G. White Engineering Corporation, New York City; third vice chairman, R. A. Millikan, director, Norman Bridge Laboratory of Physics, California Institute of Technology, Pasadena, Calif. The honorary chairman, George E. Hale, director, Mount Wilson Observatory, Pasadena, Calif., and the permanent secretary, Vernon Kellogg, National Research Council; the treasurer, F. L. Ransome, of the United States Geological Survey and treasurer of the National Academy of Sciences, together with assistant secretaries Albert L. Barrows, National Research Council; Paul Brockett, assistant secretary, National Academy of Sciences, and Alfred D. Flinn, secretary, Engineering Foundation and chairman, division of engineering, National Research Council, continue in office without annual reelection.

INTERNATIONAL RELATIONS.

The council continues to maintain close relations with scientific interests and activities in other countries through its membership in the International Research Council and its representation in the various international unions affiliated with the International Research Council. It has been successful in arranging that the American dues to the International Research Council and affiliated unions should continue to be paid by the Government through the State Department.

Delegates accredited by the council attended the meetings in Rome in May, 1922, of the International Astronomical Union and the International Union of Geodesy and Geophysics, and in Lyons in June, 1922, of the International Union of Pure and Applied Chemistry. The council has also accredited delegates to the meeting of the International Research Council and the International Union of Scientific Radio-Telegraphy, both to be held at Brussels in July, and to the International Geological Congress to be held at Brussels in August.

By Article XXIV of the League of Nations there is authorized the establishment of a committee of 12 members to propose a plan for international cooperation in intellectual labor. The League has

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established such a committee, and Dr. George E. Hale, honorary chairman of the council, was appointed member for America. The committee will hold its first meeting at Geneva in August, 1922.

During the past year and a half the council's committee on Pacific investigations has corresponded with countries and colonies within and bordering upon the Pacific Ocean with a view to the holding of a second pan-Pacific conference similar to that held in Honolulu in August, 1920. Recently the Commonwealth Government of Australia has made an appropriation to the Australian National Research Council, which will make it possible to hold this conference in Australia in the fall of 1923 under the immediate auspices of the Australian National Research Council.

PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

The council has continued to share in the editorial and financial responsibility of the Proceedings of the National Academy of Sciences. It has contributed during the year $2,500 to assist in meeting the expenses of the Proceedings, and has been represented on the managing and editorial boards by the following members of the council: Member of the executive committee, Vernon Kellogg; members of the editorial board, the chairman of the executive board and the permanent secretary and Messrs. Cottrell, Flinn, Gale, Jones, Mathews, Millikan, Ransome, Seashore, Vaughan, and Yerkes.

PUBLICATIONS.

From June 30, 1921 to July 1, 1922, 6,967 copies of the various issues in the bulletin series of the council and 10,376 copies of issues of the reprint and circular series were distributed. From the beginning to the present the total number of copies of bulletins distributed is 27,200 and of the reprints and circulars 30,842. The receipts for subscriptions to the bulletin and separate sales of bulletin and numbers in the reprint and circular series for the year totaled $1,751.68.

The following in each series have been issued or have gone to press since June 30, 1921:

BULLETIN OF THE NATIONAL RESEARCH COUNCIL.

VOLUME 2.

No. 13. The research activities of departments of the State government of California in relation to the movement for reorganization. By James R. Douglas. June, 1921. Pages, 46. Price, 60 cents.

No. 14. A general survey of the present status of the atomic structure problem. Report of the committee on atomic structure of the National Research Council. By David L. Webster and Leigh Page. July, 1921. Pages, 61. Price, 75 cents.

No. 15. A list of seismologic stations of the world. Compiled by Harry O. Wood. July, 1921. Pages, 142. Price, $2.

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VOLUME 3.

No. 16. Research laboratories in industrial establishments of the United States, ncluding consulting research laboratories. Originally compiled by Alfred D. Flinn; evised and enlarged by Ruth Cobb. December, 1921. Pages, 135. Price, $2.

No. 17. Scientific papers presented before the American Geophysical Union at its econd annual meeting. February, 1922. Pages, 108. Price, $1.50.

No. 18. Theories of magnetism. By members of the committee on theories of nagnetism. August, 1922. Pages, 261. Price, $3.

VOLUME 4.

No. 19. Celestial mechanics. Report of the committee on celestial mechanics of he National Research Council. (In press.)

No. 20. Secondary radiations produced by X-rays and some of their applications to physical problems. By Arthur H. Compton. (In press.)

No. 21. Electrodynamics of moving media. Report of the committee on electrodynamics of moving media. (In press.)

No. 22. The present status of visual science. By Leonard Thompson Troland. (In press.)

No. 23. Certain problems in acoustics. By members of the committee on acoustics of the National Research Council. (In press.)

No. 24. Algebraic numbers. Report of the committee on algebraic numbers of the National Research Council. (In press.)

No. 25. Celestial mechanics. Appendix to the report of the committee on celestial mechanics. (In press.)

No. 26. Report of the committee on luminescence. By members of the committee on luminescence. (In press.)

REPRINT AND CIRCULAR SERIES OF THE NATIONAL RESEARCH COUNCIL.

No. 13. Research problems in colloid chemistry. By Wilder D. Bancroft. June, 1921. Pages, 54. Price, 50 cents.

No. 15. Researches on modern brisant nitro explosives. By C. F. van Duin and B. C. Roeters van Lennep. Translated by Charles E. Munroe. October, 1921. Pages, 35. Price, 50 cents.

No. 18. Industrial benefits of research. By Charles L. Reese and A. J. Wadhams. August, 1921. Pages, 14. Price, 25 cents.

No. 19. The university and research. By Vernon Kellogg. August, 1921. Pages, 10. Price, 15 cents.

No. 20. Libraries in the District of Columbia. By W. I. Swanton. September 1921. Pages, 19. Price, 25 cents.

No. 21. Scientific abstracting. By Gordon S. Fulcher. December, 1921. Pages, 15. Price, 20 cents.

No. 22. The National Research Council. Its services for mining and metallurgy. By Alfred D. Flinn. November, 1921. Pages, 7. Price, 20 cents.

No. 23. American research chemicals. By Clarence J. West. September, 1921. Pages, 28. Price, 50 cents.

No. 24. Organomagnesium compounds in synthetic chemistry. A bibliography of the Grignard reaction, 1900–1921. By Clarence J. West and Henry Gilman. (In press.)

No. 25. A partial list of the publications of the National Research Council to January 1, 1922. February, 1922. Pages, 15. Price, 25 cents.

No. 26. Doctorates conferred in the sciences by American universities in 1921. Compiled by Callie Hull and Clarence J. West. March, 1922. Pages, 20. Price, 20 cents.

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No. 27. List of manuscript bibliographies in geology and geography. By Homer P. Little. February, 1922. Pages, 17. Price, 25 cents.

No. 28. Investment in chemical education in the United States. Compiled by Callie Hull and Clarence J. West. March, 1922. Pages, 3. Price, 15 cents.

No. 29. Distribution of fellowships and scholarships between the arts and sciences. Compiled by Callie Hull and Clarence J. West. April, 1922. Pages, 5. Price, 15 cents.

No. 30. First report of the committee on contact catalysis. By Wilder D. Bancroft, chairman, in collaboration with the other members of the committee. (In press.)

No. 31. The status of "clinical" psychology. By F. L. Wells. January, 1922. Pages, 12. Price, 20 cents.

No. 32. Moments and stresses in slabs. By H. M. Westergaard and W. A. Slater. April, 1922. Pages, 124. Price, $1.

No. 33. Informational needs in science and technology. By Charles L. Reese. May, 1922. Pages, 10. Price, 20 cents.

No. 34. Indexing of scientific articles. By Gordon S. Fulcher. (In press.)

No. 35. American research chemicals. First revision. By Clarence J. West. May, 1922. Pages, 37. Price, 50 cents.

No. 36. List of manuscript bibliographies in chemistry and chemical technology. By Clarence J. West. (In press.)

No. 37. Recent geographical work in Europe. By W. L. G. Joerg. (In press.)

The council issued during the year the following miscellaneous publications:

Organization and members, 1921–22.

The executive committee on natural resources. By John M. Clarke, Henry S. Graves, and Barrington Moore. Reprinted from Science, N. S., volume 53, No. 1381, pages 550–552, June 17, 1921.

The obligation of the State toward scientific research. By James Rowland Angell. Reprinted from the Centennial Memorial Volume of Indiana University. July, 1921.

Science and national progress. Reprinted from Scientific American Monthly, July, 1921. What do you know about diatoms? By H. P. Little. A national information service for science and technology. By Ruth Cobb.

Science and national progress. Reprinted from Scientific American Monthly, August, 1921. Balloons, helium gas, and the age of the earth. By Homer P. Little.

A more definite statement of the highway research work. By W. K. Hatt. Reprinted from Automotive Industries, August 11, 1921.

The rôle of research in waste elimination. By Harrison E. Howe. From Chemical and Metallurgical Engineering, August 31, 1921.

Science and national progress. Reprinted from Scientific American Monthly, October, 1921. Topographic maps: What they are, who uses them, and how. By Homer P. Little.

Preservation of natural conditions. By the Ecological Society of America. Reprinted for the committee with the aid of the National Research Council. November, 1921.

A problem in the education of college students of superior ability. By George Walter Stewart. Reprinted from School and Society, November 19, 1921.

The National Research Council. By Vernon Kellogg. Reprinted from the Educational Review, volume 62, No. 5, December, 1921.

Geology as a profession. By H. P. Little. Reprinted from Science, N. S., volume 54, No. 1408, pages 619–622, December 23, 1921.

Zoological research as a career. By C. E. McClung. Reprinted from Science, N. S., volume 54, No. 1408, pages 617–619, December 23, 1921.

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Research in the field of agriculture. By A. F. Woods. Reprinted from Science, January 20, 1922, volume 55, No. 1412.

Research in civil engineering as a career. By Alfred D. Flinn. Reprinted from Engineering News-Record, January 26, 1922.

Anthropology as a career. By Clark Wissler. Reprinted from the Indiana University Alumni Quarterly, January, 1922.

The research information service of the National Research Council, February, 1922.

Opportunities for a research career in medical science. By George W. McCoy. Reprinted from the Journal of the American Medical Association, February 18, 1922, volume 78, pages 533 and 534.

The field for chemists. By Wilder D. Bancroft. Reprinted from the Journal of Industrial and Engineering Chemistry, volume 14, No. 2, February, 1922.

Destruction of piling in water-front structures: Its prevention. By committee on marine piling investigations of the National Research Council, February, 1922.

The explosibility of ammonium nitrate. By Charles E. Munroe, chairman committee on the investigation of the explosibility of ammonium compounds, National Research Council. Reprinted from Chemical and Metallurgical Engineering, volume 26, No. 12, March 22, 1922.

Sectioning classes on the basis of ability. By C. E. Seashore. Reprinted from School and Society, April 1, 1922, volume 15, page 353.

Geography as a profession. By H. P. Little. Reprinted from Science, volume 55, No. 1423, April 7, 1922.

Psychology as a career. By C. E. Seashore. Reprinted from Science, volume 55, No. 1424, April 14, 1922.

FELLOWSHIPS.

The administration of scientific fellowships by the council has assumed very large proportions. In addition to $500,000, to be expended over a period of five years, provided by the Rockefeller Foundation as from the middle of 1919 for research fellowships in physics and chemistry, the council has now been intrusted with the administration of $500,000 more by the Rockefeller Foundation and General Education Board, acting jointly, for fellowships in medicine, and with $17,500 more from certain companies interested in chemical industry for fellowships in the relations of chemical products to agriculture.

There were on June 30, 1922, 18 fellowships in physics, 28 in chemistry, and 13 in medicine. The medical fellowships are administered, as are the fellowships in physics and chemistry, by a special board appointed by the council of men of recognized eminence in their scientific fields. The board for the medical fellowships is as follows: David L. Edsall, professor of medicine and dean of the medical school, Harvard University; Joseph Erlanger, professor of physiology, school of medicine, Washington University, St. Louis; G. Carl Huber, professor of anatomy and director of anatomic laboratory, University of Michigan; E. O. Jordan, professor of bacteriology, University of Chicago; Dean Lewis, professor of surgery, Rush Medical School, Chicago; W. G. MacCallum, professor of

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pathology and bacteriology, Johns Hopkins University; Lafayette Mendel, professor of physiological chemistry, Yale University; W. W. Palmer, professor of medicine, Columbia University; and the chairman of the division of medical sciences of the National Research Council, chairman ex officio.

The board for the administration of the fellowships in physics and chemistry is as follows: Simon Flexner, chairman, director of research laboratories, Rockefeller Institute for Medical Research, Sixty-sixth Street and Avenue A, New York City; George E. Hale, director, Mount Wilson Observatory, Carnegie Institution of Washington, Pasadena, Calif.; John Johnston, Sterling professor of chemistry, Yale University, New Haven, Conn.; Elmer P. Kohler, professor of chemistry, Harvard University, Cambridge, Mass.; R. A. Millikan, director, Norman Bridge Laboratory of Physics, California Institute of Technology, Pasadena, Calif.; Augustus Trowbridge, professor of physics, Princeton University, Princeton, N. J. Ex officio: E. W. Washburn, chairman, division of chemistry and chemical technology, National Research Council; William Duane, chairman, division of physical sciences, National Research Council. Dr. W. E. Tisdale, secretary of the division of physical sciences, National Research Council, acts as executive secretary for the board.

The Texas Gulf Sulphur Co. has appropriated a sum of $10,000 for the support during the fiscal year 1922–23 of fellowships to be established under the division of biology and agriculture of the National Research Council for fundamental research in the agricultural applications of sulphur. In accepting the appropriation the National Research Council has reserved the right to publish, without restriction, the results obtained under these fellowships. The fellowships are administered by a special committee operating under the division of biology and agriculture.

A sum amounting to $2,000 annually has been made available during the 1920–21, 1921–22, and 1922–23 by Mr. Julius Rosenwald, of Chicago, for the purpose of developing scientific men among the Negro race in America. This fellowship has been awarded to Mr. E. E. Just, of Howard University, Washington, D. C.

FEDERATION OF BIOLOGICAL SOCIETIES.

An important movement to federate the American biological organizations which are of a research character and which are essentially national in scope (without destruction or constraining modification of the individual organizations) has been sponsored by the council. There are nearly a score of these national biological societies, with a total membership of over 6,000, almost wholly uncorrelated, yet the plain present tendency of work in biological science is toward a breaking down of the artificial boundaries thrown

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up about each of the special fields of biology represented by these various societies. The students of genetics, for example, are equally interested in work done with plants and with animals.

To the end of developing a correlation among these societies an informal conference of representatives of the council's division of biology and agriculture and representatives of some of these leading societies and of the biological sections of the American Association for the Advancement of Science was held at Toronto in December, 1921 (at the time of the meetings of the American association and several of the biological societies), at which it was decided to hold later a formal conference. This second conference was held in the council's rooms in Washington in April, 1922. It was participated in by accredited representatives of 18 national biological societies, representatives of Sections F, G, N, and O of the American Association for the Advancement of Science and representatives of the council's division of biology and agriculture. A general agreement as to the high desirability of forming such federation of these various national agencies for the promotion of biological science was reached and an executive committee to draft a constitution and by-laws for the proposed federation appointed.

It was also agreed that perhaps the most important present special service the federation could serve was the promotion of more adequate means of publication than now exist and, especially, means of providing for a comprehensive biological abstracting journal. A special joint committee representing the division of biology and agriculture of the council on the one hand and the federation on the other was set up. This committee is to study the whole question of biological publications and report the results of its study, with recommendations for action.

CONCILIUM BIBLIOGRAPHICUM.

Representing both the council and the Rockefeller Foundation, the permanent secretary of the council made a detailed investigation in Zurich during the summer of 1921 of the status of the Concilium Bibliographicum, an organization founded and largely maintained by the activities of an American, Dr. Herbert Haviland Field, as an international institution of scientific bibliography. Because of the difficulties produced by the war and the later sudden death of Doctor Field in April, 1921, the Concilium, which had been performing a bibiliographic service of much usefulness to zoologists, anatomists, physiologists, and general biologists, found itself threatened with complete collapse. It had contracted debts for the payment of which no resources except its building, technical equipment, and stock of bibliographic cards were available. The use of these resources would have destroyed the institution.

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As a result of the examination and report of the permanent secretary, the council adopted a plan for the rehabilitation of the Concilium, outlined in the report, which involved an arrangement as to control of the Concilium jointly by the council and the Swiss Society of Natural Sciences until some more widely representative international organization could take it over, and an appeal to the Rockefeller Foundation for an appropriation sufficient to clear off the outstanding obligations of the Concilium, return to the widow of Doctor Field a small part, at least, of the money advanced to the Concilium from Doctor Field's private funds, and assist in the current expenses of the institution during five years, at the end of which time it is hoped the Concilium may be self-sustaining or internationally subventioned.

In conformity with the recommendations of the council the Rockefeller Foundation has appropriated to the council $85,000 to be expended under the general direction of the council for the purposes above stated. Of this money, $15,000 is to meet the obligations already incurred by the council and the remainder ($70,000) is to be devoted to current expenses through five years.

By arrangement with the Swiss Society of Natural Sciences the immediate management of the Concilium is vested in a director, working under the general control of a joint commission consisting of one member, representing the Swiss society, and one representing the council. Dr. J. Strohl, of the University of Zurich, and formerly chief technical assistant in the Concilium, has been named as director and commission representative of the Swiss society and Vernon Kellogg as commission representative of the council. A special committee of the council on Concilium Bibliographicum matters has been appointed, with the following members: Vernon Kellogg, chairman; L. R. Jones, professor of plant pathology, University of Wisconsin; R. M. Yerkes, chairman, research information service, National Research Council; and J. R. Schramm, executive secretary, division of biology and agriculture, National Research Council.

In order that this committee and its representative on the joint managing commission might have competent advice as to the desires of American biologists and librarians, who constitute one-third of all the subscribers to the bibliographic cards issued by the Concilium, concerning the future activities of the Concilium, a conference of representative American biologists and librarians was held in the council rooms on April 24, 1922.

PERSONNEL RESEARCH FEDERATION.

The Personnel Research Federation, organized as a result of conferences held in the council's rooms in November, 1920, and March, 1921, held its first annual meeting in the council's rooms in

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November 21, 1921. The meeting was well attended, rich in valuable papers, and stimulating in its discussions. A committee was appointed to act on a proposition for establishing a journal. An acceptable contract having been made with publishers and an editorial board created, the first issue of the monthly, The Journal of Personnel Research, appeared in May, 1922. Mr. Leonard Outhwaite is the editor in chief. Dr. Beardsley Ruml served the Federation as director from spring to fall of 1921; Mr. Outhwaite succeeded Dr. Ruml.

Without special effort, the Federation has made substantial gains in its membership, which now includes organizations engaged in personnel research, universities, governmental departments, the American Federation of Labor, and individuals.

The officers of the Personnel Research Federation are: Chairman, Robert M. Yerkes; vice chairman, Samuel Gompers; secretary, Alfred D. Flinn; treasurer, Robert W. Bruere.

At the annual meeting the chairman in his address outlined the purposes of personnel activities and research and spoke of changes in work and workers resulting therefrom as industry developed. Other papers were:

"Basic experiments in vocational guidance," C. S. Yoakum; "An experimental study on retardation in relation to satisfaction on the job in a metal manufacturing plant," Joseph W. Hayes; "Methods and results in selection of students for engineering training," L. L. Thurstone; "Posture in occupations as related to health," L. R. Thompson; "Determination of carbon monoxide in the blood and its effects on the worker," R. R. Sayers; "Problems of personnel research of interest to organized labor," Samuel Gompers; "Difficulties encountered in a cause-of-leaving research," Miss Anna Bezanson.

The office of the Federation is in the Engineering Societies Building, 29 West Thirty-ninth Street, New York, by courtesy of the Engineering Foundation.

SCIENCE SERVICE.

Science Service, established in April, 1921, under the joint auspices of the council, the National Academy of Sciences, and the American Association for the Advancement of Science, has made rapid progress in its work in the popularization of science. It has been aided by an annual subvention of $30,000 from Mr. E. W. Scripps, of Cincinnati, Ohio, and has had during the past year an income from sales of its scientific articles and news notes of about $20,000 for the same year.

It maintains a weekly (soon to be converted into a daily) Science News Bulletin which is subscribed for by about 40 newspapers, mostly of large circulation, and a special feature service subscribed for by a similar number of newspapers. It has provided, during the year, numerous articles, long and short, for standard magazines, has

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arranged for the publication of a number of popular scientific books, has issued a motion picture on a timely scientific subject, and has, especially in the person of its editor, Dr. E. E. Slosson, provided numerous popular scientific lectures. Science Service is helping fill the need in America of a means of disseminating authentic scientific information and news in understandable and interesting form.

AMERICAN SCIENTIFIC LITERATURE FOR RUSSIAN SCIENTIFIC INSTITUTIONS.

An American committee to aid Russian scientists consisting of Vernon Kellogg, chairman; and Messrs. L. O. Howard, Chief, United States Bureau of Entomology; David White, Chief Geologist, United States Geological Survey; and Raphael Zon, forest economist, United States Forest Service, all members of the council, but not acting as an official council committee, was formed in the spring of 1922. This committee issued an appeal to American scientific men, organizations, and publishing houses for gifts of American scientific books, journals, and papers issued since January 1, 1915, to be distributed free to Russian universities and investigators, who had received practically no American scientific publications issued since the beginning of the war.

The committee was able to arrange for the generous cooperation with it of the American Relief Administration, under the chairmanship of Hon. Herbert Hoover, which offered to undertake the receipt and proper packing in New York of all material contributed and to provide for the free transportation of the material overseas and into Russia (Moscow). The administration also gave the use of the services of its American agents scattered through Russia to help assure a safe and proper distribution of the material sent over. A special Russian committee of eminent scientific men, principal universities, the academy of science, and other major scientific organizations was set up in Moscow to assist in the distribution.

A widespread and generous response was made by American Government and State scientific bureaus, experiment stations, scientific societies, university presses, and other publishers of scientific books and journals and by individuals to the appeal of the committee, which has enabled the committee to collect and send to Moscow, about twelve tons of scientific books, journals, and papers, all issued since January 1, 1915, and, mostly, of undoubted value to Russian scientific investigators and teachers.

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REPORTS OF DIVISIONS.

DIVISION OF FEDERAL RELATIONS.

[CHARLES D. WALCOTT, Chairman.]

(For list of members see Appendix A.)

The activities of the division of Federal relations during the past year have been chiefly confined to those of the committee on scope of Government service. Because of the resignation of Dr. C. L. Alsberg, chairman of this committee, from the United States Bureau of Chemistry and his removal to California and consequent resignation of the chairmanship of the committee, Dr. H. Foster Bain, Director of the Bureau of Mines, was made chairman in his stead. A report by this committee is under process of preparation. Dr. Bain has held numerous conferences with various representatives of Government scientific bureaus in connection with the preparation of this report.

The division as it stands has as members representatives from Government departments and bureaus as follows:

Department of State: Consular Service.
Department of Treasury: Public Health Service.
Department of War:
- General Staff.
- Military Intelligence Division.
- Coast Artillery.
- Medical Corps.
- Engineer Corps.
- Ordnance Department.
- Signal Corps.
- Air Service.
- Chemical Warfare Service.

Department of Justice.
Post Office Department.
Department of Navy:
- Intelligence Division.
- Bureau of Navigation.
- Bureau of Yards and Docks.
- Bureau of Ordnance.
- Bureau of Construction and Repair.
- Bureau of Steam Engineering.
- Bureau of Medicine and Surgery.

Department of the Interior:
- Patent Office.
- Geological Survey.
- Reclamation Service.
- Bureau of Education.
- Bureau of Mines.

Department of Agriculture:
- Weather Bureau.
- Forest Service.

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Department of Agriculture—Continued.
Bureau of Animal Industry.
Bureau of Plant Industry.
Bureau of Chemistry.
Bureau of Soils.
Bureau of Entomology.
Bureau of Biological Survey.
Bureau of Public Roads.
Department of Labor: Bureau of Labor Statistics.
Department of Commerce:
Coast and Geodetic Survey.
Bureau of Standards.
Bureau of Fisheries.
Bureau of the Census.
Bureau of Lighthouses.
Smithsonian Institution.

DIVISION OF FOREIGN RELATIONS.

[R. A. MILLIKAN, Chairman.]

(For list of members, see Appendix A.)

The annual meeting of the division was held in Washington on April 21, 1922. At this meeting reports were presented from the American sections of the following international scientific organizations with which the council has affiliations by representatives of these sections as named:

International Astronomical Union: Joel Stebbins, professor of astronomy, University of Illinois.

American Geophysical Union: W. J. Humphreys, professor of meteorological physics, United States Weather Bureau.

International Union of Pure and Applied Chemistry: F. G. Cottrell, chairman, division of chemistry and chemical technology, National Research Council.

International Mathematical Union: L. E. Dickson, professor of mathematics, University of Chicago.

International Union of Scientific Radio-Telegraphy: L. W. Austin, head of United States Naval Radio Research Laboratory.

International Bureau of Weights and Measures: S. W. Stratton, Director, United States Bureau of Standards.

International Commission on Illumination: E. P. Hyde, director, Nela Research Laboratory, General Electric Co., Cleveland, Ohio.

International Electro-Technical Commission: C. O. Mailloux, president, United States National Committee, 111 Fifth Avenue, New York.

DELEGATES TO 1922 MEETINGS OF INTERNATIONAL RESEARCH COUNCIL AND AFFILIATED UNIONS.

The following delegates were accredited by the council to meetings, as indicated, of the International Research Council and affiliated unions, as follows:

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INTERNATIONAL RESEARCH COUNCIL, BRUSSELS, JULY 25.

James H. Breasted, professor of Egyptology and oriental history, University of Chicago.
George E. Hale, director, Mount Wilson Observatory, Pasadena.
Robert A. Millikan, director, Norman Bridge laboratory of physics, California Institute of Technology.
Augustus Trowbridge, professor of physics, Princeton University.

INTERNATIONAL ASTRONOMICAL UNION, ROME, MAY 2.

R. G. Aitken, astronomer, Lick Observatory, University of California.
L. A. Bauer, director, Department of Terrestrial Magnetism, Carnegie Institution of Washington.
William Bowie, chief, division of geodesy, United States Coast and Geodetic Survey.
H. D. Curtis, director, Allegheny Observatory, University of Pittsburgh.
Edward Kasner, professor of mathematics, Columbia University.
O. J. Lee, astronomer, Yerkes Observatory, University of Chicago.
Frank B. Littell, astronomer, United States Naval Observatory.
Henry N. Russell, professor of astronomy and director of observatory, Princeton University.
John A. Miller, director, Sproul Observatory, Swarthmore College.
C. E. St. John, astronomer, Mount Wilson Observatory.
Frank Schlesinger, director of observatory, Yale University.
F. H. Seares, astronomer, Mount Wilson Observatory.
Harlow Shapley, astronomer, Harvard College Observatory.

INTERNATIONAL GEODETIC AND GEOPHYSICAL UNION, ROME, MAY 2.

L. A. Bauer, director, department of terrestrial magnetism, Carnegie Institution of Washington.
William Bowie, chief, division of geodesy, United States Coast and Geodetic Survey.
H. H. Kimball, meteorologist, United States Weather Bureau.
G. W. Littlehales, hydrographic engineer, United States Hydrographic Office.
Harry Fielding Reid, professor of dynamical geology and geography, Johns Hopkins University.
Frank Schlesinger, director of observatory, Yale University.
H. S. Washington, petrologist, Geophysical Laboratory, Carnegie Institution of Washington.

INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY, LYONS, JUNE 28.

Edward Bartow, head department of chemistry, University of Iowa.
E. S. Chapin, American representative, Textile Alliance, Paris.
R. B. Moore, chief chemist, United States Bureau of Mines.
Charles L. Parsons, secretary, American Chemical Society.
E. W. Washburn, professor of ceramic engineering, University of Illinois.
H. S. Washington, petrologist, Geophysical Laboratory, Carnegie Institution of Washington.

INTERNATIONAL UNION OF SCIENTIFIC RADIO-TELEGRAPHY, BRUSSELS, JULY 24.

E. F. W. Alexanderson, General Electric Co.
L. W. Austin, head of United States Naval Radio Research Laboratory.
A. E. Kennelly, professor of electrical engineering, Harvard University.

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INTERNATIONAL GEOLOGICAL CONGRESS, BRUSSELS, AUGUST 10.

E. B. Mathews, professor of mineralogy and petrography, Johns Hopkins University.

The council made appropriations amounting in all to $3,100 to assist in the payment of travel expenses of the delegates accredited by it to the various international meetings.

International dues.—By an appropriation in the Diplomatic and Consular bill funds were made available for the payment of 1921 dues to the following international organizations:

International Research Council	$129
International Union of Pure and Applied Chemistry	290
International Astronomical Union	772
International Union of Geodesy and Geophysics	1,338
International Mathematical Union	129

These dues are payable in francs, and appropriation in dollars was based on the rate of exchange current at the time of the drawing of the bill. By the time, however, that the money could be remitted by the State Department to meet these dues, the exchange value of the franc against the dollar had increased, and the Government appropriation in dollars was unable to meet the full payments in francs. This deficit amounted altogether to $463.37, which was paid by the council. In the bill providing for the appropriation for 1922 dues the value of the franc was calculated at an advanced rate, and it is expected that little, if any, deficit will occur in the appropriation in dollars for meeting these dues.

International station at Ukiah for variation of latitude.—A deficiency appropriation of $2,000 was secured from the Government through the good offices of the Department of State with which to meet the expenses of the international station at Ukiah for the fiscal year ending June 30, 1922. It will also probably be possible to repay from this sum certain grants which were made from special funds of the National Academy of Sciences and the National Research Council in order to carry the expenses of this station over an emergency period in 1921.

A second item of $2,000 for this same account has been made in the State Department's regular appropriation bill for 1922–23. It is expected that by the middle of 1923 arrangements will be made for the transfer of the property of this international station to American auspices and for continuation of the program of this station in cooperation with stations in Japan and Italy.

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DIVISION OF STATES RELATIONS.

[JOHN C. MERRIAM, Chairman.]

(For list of members, see Appendix A.)

The annual meeting of the division was held in Washington May 23, 1922. The following papers were presented:

The present status of forestry under State auspices, and the problem of the organization of science under State control: H. S. Graves, dean, School of Forestry, Yale University.

The present status of research in State geological surveys: E. B. Mathews, professor of mineralogy and petrography, Johns Hopkins University.

Cooperation in research under public agencies: E. W. Allen, Division of States Relations, Department of Agriculture.

Summarization of report upon survey of scientific work in Illinois: Leonard D. White, associate professor of political science, University of Chicago.

Fundamental considerations affecting the relation of research to public administration: John C. Merriam, president, Carnegie Institution of Washington.

Illinois survey.—An elaborate report was submitted by Dr. Leonard D. White, associate professor of political science, University of Chicago, upon "The organization and activities of the scientific departments of the State government of Illinois." This report is the second—the first was on California—in a series of similar reports for which the division has arranged. The purpose of these reports is to disclose the conditions at present surrounding the position of scientific research in governmental agencies and the place which research ought to occupy in public administration. It is planned to publish soon the greater part of this Illinois report.

Report of Government scientific work in cooperation with non-Federal agencies.—A report upon this subject has been drafted by Dr. E. W. Allen, which it is planned to publish.

Report of California committee on scientific research of the California State council of defense.—The final report, dated January 31, 1919, has been revised and its publication authorized by the secretary of state of California. The council believes that this will be a useful paper for it to publish in view of the unique character of the organization of this committee and of the effectiveness of its work.

Conditions surrounding geological research under State auspices.—At the request of the division of states relations the division of geology and geography undertook to prepare a report upon the conditions surrounding geological research under State auspices. This report was presented at the annual meeting of the division.

Study of conditions in State forest services.—Dean Graves, chairman-elect of the division, has undertaken to make an extensive personal study of the conditions in State forest services and at the same time to give attention to research possibilities in forestry and conditions surrounding research in this field under State auspices. To make

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this study Dean Graves has undertaken to visit many of the States of the Union.

Study of centralization in State government.—The major undertaking of the division for the coming year will be a study of the tendency toward the centralization of government and its effect upon the freedom for research in State educational and scientific institutions. This study will begin probably in the States of Massachusetts and Maryland and will then be extended to Wisconsin and Illinois.

DIVISION OF EDUCATIONAL RELATIONS.

[VERNON KELLOGG, Chairman.]

(For list of members, see Appendix A.)

The annual meeting of the division was held in Washington on April 19, 1922. The period of the meeting was mostly given over to a discussion of the problem presented by the gifted student in the colleges and universities and of the ways and means for prosecuting work on this problem. The chairman stated that the principal activities of the division during the year had related to this problem, and proposed that the division, in continued collaboration with the division of anthropology and psychology, should continue to give special attention to this problem during the coming year. After some discussion of ways and means of carrying on the work this proposal was adopted.

Special conference on problem of the gifted student.—On December 23, 1921, a special conference on the problem of the gifted student was held in the council's rooms at Washington, in which invited representatives—presidents, deans, and professors—of about a dozen colleges and universities participated. A report of this conference, with abstracts of the prepared papers and of the general discussion, was given wide circulation among the colleges and universities of the country and attracted much favorable attention. It was the unanimous opinion and recommendation of this conference that the council, through its divisions of educational relations and anthropology and psychology, should continue to keep this problem before college and university administrators and faculties, both by correspondence, the issuance of bulletins and pamphlets, and by personal visits by representatives of the council.

"Open letter to college seniors" and "career bulletins."—In response to many suggestions the division arranged for the preparation by Dean Seashore, of the University of Iowa, and publication of an "Open letter to college seniors," calling attention to the opportunities afforded the senior class men and women of superior mental endowment for a career of scholarships. This "Open letter" met from the beginning of its distribution with such a favorable reception that repeated printings were necessary to supply the demand first made

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on the division by university and college presidents and deans. About 15,000 copies have been sent on this personal demand.

In addition arrangements have been made for the preparation by competent authorities—in most cases the chairmen of the council's divisions of science and technology—for special "career bulletins," calling the attention of university students to the opportunities for research careers on the part of competent men and women, in each of the principal fields of scientific work. Such bulletins have so far been prepared and published for the fields of agriculture, anthropology, chemistry, civil engineering, geography, geology, medicine, psychology, and zoology. Other bulletins are now in course of preparation.

Honors systems.—As a result of the consideration by the conference of December 23, 1921, of the advantages of the development of some form or forms of honors systems in American colleges and universities a special committee, consisting of President Aydelotte, of Swarthmore College, and the chairman of the division, was appointed to collect information concerning the extent to which honors systems are now in vogue in this country and the character of the various systems adopted and to prepare a report on the basis of this information for general circulation among college and university administrators and faculties. The work of collecting the information is practically completed and the report in course of preparation.

Assistance to committee G, on methods of increasing the intellectual interest and raising the intellectual standards of undergraduates of the American Association of University Professors.—Under the chairmanship of Prof. E. H. Wilkins, of the University of Chicago, committee G, on methods of increasing the intellectual interest and raising the intellectual standards of undergraduates of the American Association of University Professors, is attempting to prepare a full bibliography of books and articles referring to the general subject of the committee's interests. Part of the bibliographic work of the committee covers the special subject of the problem of the gifted student, and the division has made an appropriation of $500 to assist the committee in its work as far as it applies especially to the gifted-student problem. The work of the committee is now being actively prosecuted.

Report on research conditions in American colleges and universities.—As a result of the work done by the division (with the financial support of the General Education Board) during the last two years on an investigation of the research situation in the colleges and universities of the country, which included personal visits to about 200 institutions by representatives of the division, there is now on hand a large amount of informative material in the shape of reports from college and university authorities and reports of the visitors. The chairman of the division hopes to complete a general report on the subject, suitable for publication, during the coming year.

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DIVISION OF RESEARCH EXTENSION.

[H. E. Howe, Chairman.]

(For list of members, see Appendix A.)

The annual meeting of the division was held in Washington on April 22, 1922.

The division of research extension in addition to developing certain projects peculiarly its own has, through its chairman and secretary, aided actively in the promotion of certain projects of other divisions, especially such as require financial support from outside sources. Among these may be mentioned the projects in charge of the committees on atmosphere and man, standardization of biological stains, vestibular research, marine piling investigations, food and nutrition, etc. All work in connection with the finding of funds from industrial concerns for the support of scientific investigation has been made very difficult and slow during the year by the unsettled financial and industrial condition of the country.

Committee on corrosion.—Progress in the work of the division's committee on corrosion has been made in the way of bibliographic work, and the preparation of a monographic review of the present status of corrosion investigation. A large corporation has, at the suggestion of the committee, placed a special investigator on corrosion work.

Alloys research information service.—Little advance has been made during the past year on this project, as the time does not seem yet ripe in the industrial world for the securing of definite contracts for the support of the work. On the other hand, there is almost universal approval of the idea and plan, and with the coming of better financial conditions the support necessary for the development of the work of the service should not be difficult to obtain.

Tanning research institute and school.—A report, making certain recommendations, on the subject of establishing a research institute or laboratory to prosecute scientific investigations of problems in tanning, and the creation of a special tanning school has been made and accepted by the Tanners' Council. A research laboratory in Cincinnati is now active, and it is expected that the Tanners' Council will take full action in connection with the recommendations embodied in the report.

National Textile Institute.—The effort to establish a national Textile institute has met with little success so far because of the present impossibility of obtaining the large funds necessary to its support. Nevertheless some progress has been made in enlisting the interest and approval of various organizations. The Bureau of Standards has begun a research program in connection with textiles, and a committee composed of representatives of the council, the Bureau of

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Standards, the American Home Economics Association (especially representing the consumers) and various associations of textile manufacturers is being organized.

National Institute of Nutrition.—In connection with the efforts of the division of biology and agriculture and the division of research extension, a report similar to that on National Textile Institute must be made. The necessarily large funds needed for the support of such an institute have not been found, although certain encouraging assurances of assistance have been secured.

Crop Protection Institute and Horological Institute.—These two organizations, which were initiated and sponsored by the division, are now well established and actively at work.

The annual meeting of the Crop Protection Institute was held in Rochester on January 12, 1922. The membership of the institute now comprises 256 scientific members, 25 industrial concern members, and 21 associate industrial members. Various funds are now in the hands of the institute for the prosecution of particular investigations.

The present membership of the Horological Institute of America is as follows: Patrons 2; life members, 20; sustaining members, 32; active members, 97. There is about $4,000 in the treasury.

RESEARCH INFORMATION SERVICE.

[ROBERT M. YERKES, Chairman.]

(For list of members, see Appendix A.)

The annual meeting was held in Washington, April 10, 1922. A report of the year's work was presented by the chairman and the matter of the further development and extension of the Service and its establishment on a secure and sufficient financial basis was discussed at length. There was general approval of the idea of expanding the Service to an extent sufficient to make it a nationally useful clearing house for information in science and technology. It was estimated that to enable the Service to develop in such a way as to meet satisfactorily such a conception of it would require an annual expenditure on its part of at least $50,000 a year for the next few years and $100,000 a year thereafter. It was considered probable, however, that part of this income could be provided by the Service itself from subscriptions for its services.

Staff.—The present staff provides the services of a chairman and a number of scientific associates, technical assistants, clerks, and stenographers. However, a part of the time of all the members of the staff is taken up by duties connected with the council's publications and other activities so that the actual staff services at present available to the Service may be estimated as follows: Chairman,

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one-half time; scientific associates, equivalent to three on full time; technical assistants, equivalent to three on full time; clerks and stenographers, equivalent to six on full time.

Miscellaneous request service.—During the year nearly 2,000 requests for scientific information were answered, and in addition a large number of intramural requests were cared for. The requests are almost equally divided between science and technology. The degree of satisfactoriness of the replies to the recipients is indicated by the following tabulation of expressions on the part of the questioners: Seventy-two per cent satisfactory information or reference; 25 per cent incomplete but useful replies; 3 per cent "no new information;" slightly less than 1 per cent "unsatisfactory." It seems clear that the miscellaneous request service is worth fostering, especially if the larger plans for the extension of the informational work of the Service can be realized.

Development of informational machinery.—The personnel file of persons now engaged in this country in scientific and technologic investigation has grown rapidly. It now contains reasonably complete and up to date records for about 14,000 such persons. This entire file is in process of "findexing," which, because of the preparation of codes for the several sciences and branches of technology and preparation of the findex cards, is a very large undertaking. The findexing of the records for chemists, physicists, and psychologists is already completed. The value and use of this file is indicated by the fact that between one-fourth and one-third of all the miscellaneous requests for information are answered partially or wholly by reference to this file.

Research laboratories file.—A resurvey of American industrial research laboratories and of their personnel was completed during the year and a revised bulletin listing them and giving information concerning their extent, character, and personnel published. It has been the most called-for bulletin issued by the Service. The file is being constantly supplemented and kept up to date.

Library of reference and source books.—About 200 volumes were accessioned during the year at a cost of about $1,000. More money, at least $2,500 a year, is needed for the proper maintenance of this library.

Bibliographic file and section.—In collaboration with other divisions of the council, and with individual specialists in various parts of the country, the Service has arranged for the compilation of lists of both published and unpublished manuscripts in science and technology. A list of manuscript bibliographies for geology and geography has already been published, and similar lists for chemistry, physics, and mathematics are in press; others are in course of preparation. Lists of published bibliographies for geology, physics, chemistry, astron-

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omy, and mathematics are well advanced and will be completed and published during the coming year. Altogether the progress of this important part of the Service's informational machinery has been rapid and substantial and the promise of usefulness through it is great, for there is no more serious wastage of investigators' time than in duplication of search and listing of references.

Special survey of informational sources of the world.—The Service in connection with the consideration of a possible future considerable extension of the scope of its work, arranged with Mr. J. David Thompson, an expert investigator, to make a special survey of the informational sources of the world, in order that the Service and the council might have before them during their consideration of the future development of the service a needed collection of data concerning other important informational organizations. Mr. Thompson's survey was conducted promptly in consultation with officers and members of the Service and with various specialists in Washington and New York. The survey was made use of by Messrs. Yerkes (chairman of the service) and Flinn (chairman of the division of engineering) in connection with their work of drawing up a plan for the further development and expansion of the service. This plan, approved by formal action of the service, was presented to the executive board of the council at its meeting on April 26, 1922, and referred to a special committee appointed to consider it and report back to the board.

Informational publications.—Much of the work undertaken by the Service on special request, or in the development of its informational aids, results in the compilation of scientific information which is worthy of special circulation by publication. Indeed, issuance of informational bulletins and circulars would appear to be one of the important special functions of the Service.

The following are publications issued by the council during the year for which the Service is partly or wholly responsible:

Libraries in the District of Columbia; Scientific Abstracting, being a description of methods, by Gordon S. Fulcher; American Research Chemicals, a list of commercial sources; Organomagnesium Compounds in Synthetic Chemistry, a bibliography of the Grignard reaction, 1900–1921; A partial list of Publications of the National Research Council to January 1, 1922; Doctorates Conferred in the Sciences by American Universities in 1921; Distribution of Graduate Fellowships and Scholarships between the Arts and Sciences; Investment in Chemical Education in the United States; Informational Needs in Science and Technology; A List of Seismological Stations of the World; Research Laboratories in Industrial Establishments of the United States, Including Consulting Research Laboratories, second edition, revised and enlarged.

Public announcements concerning the service.—A card announcement of Research Information Service was printed in an edition of 5,000 copies and distributed to libraries and similar institutions for use on bulletin board. A brief description of the Service was printed as

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12-page folder in an edition of 15,000 copies. This has been supplied to chairmen of divisions of the council and is being distributed principally in connection with letters.

Four news announcements relative to special activities of the service have been sent to scientific and technological publications. Free advertising space, full page or half page, has been secured irregularly in Journal of American Optical Society. One-half page advertising space has been purchased in Science for six issues, only one of which has appeared.

The purposes and plans of the Information Service have been presented by members of the staff in addresses or demonstrations before some 15 scientific and technological audiences.

Examples of special projects and requests cared for by the service.— The service is frequently asked to render services which require relatively large expenditure of time. Whenever practicable the response is favorable. The following list of special projects indicates the variety and extent of demand. Such tasks as those mentioned use not far from one-fourth of the time of the staff:

Survey of students in chemistry and expenditure for chemical instruction and research in American institutions, for Chemical Foundation.

List of research chemicals manufactured in the United States, for American chemists.

List of American laboratories well supplied with chemical periodicals and check list of chemical publications in same, for American chemists.

Revision and supplementation of council's list of periodical bibliographies and abstracts of the world, for publication.

Compilation of list of doctorates conferred in 1920–21 by American institutions, for publication, and supplementation of personnel file.

Compilation of bibliography on corrosion, for division of research extension.

Union list of periodicals in the District of Columbia, as a local service.

Compilation of a bibliography of chemical warfare, for American chemists.

Preparation of list of scientific instruments and other equipment available for loan or exchange, for American investigators.

Survey of published and unpublished lists of genera and species, for division of biology and agriculture.

Survey of current interest and investigations in problems of sex, for division of medical sciences.

Statistical study of distribution of research interest and activity in psychology, for American psychologists.

Cooperation with Personnel Research Federation by supplying information.

Cooperation with division of engineering in conducting survey of highway research.

Promotion of abstracting and listing of scientific and technological literature through preparation of reports, conference, and plans for abstracting.

A survey of sources of funds for support and encouragement of research, for publication.

Compilation of mental and educational tests for division of anthropology and psychology.

Survey of seismological stations of the world in cooperation with geophysical union.

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DIVISION OF PHYSICAL SCIENCES.

[H. G. GALE, Chairman.]

(For list of members, see Appendix A.)

For the year beginning July 1, 1921, the division elected to operate with a part-time chairman and a full-time executive secretary. Dr. W. E. Tisdale was selected to act in this latter capacity.

The annual meeting of the division was held in Washington on April 23, 1922. At this meeting the division approved the plan for the continuance of the activities of special committees as the most effective arrangement for promoting the interests of the division. As the special appropriation from the Rockefeller Foundation which had been available for the support of these committees during the years 1919–20 and 1920–21 was exhausted on June 30, 1922, a special appropriation of $5,000 was made by the council for the support of these committees during the year 1922–23.

Reports of special committees.—The division has completed reports which have been published in the bulletin series of the council, as follows:

Bulletin No. 5. The quantum theory, by E. P. Adams.

Bulletin No. 6. Data relating to X-ray spectra, by William Duane.

Bulletin No. 7. Intensity of emission of X-rays and their reflection from crystals, by Bergen Davis; and problems of X-ray emission, by D. L. Webster.

Bulletin No. 10. Report on photoelectricity, by A. Ll. Hughes.

Bulletin No. 14. A general survey of the present status of the atomic structure problem, by D. L. Webster and Leigh Page.

There is now in press manuscript for further bulletins representing the work of the following: Committees on acoustics; algebraic numbers; celestial mechanics; celestial mechanics, part II; luminescence; mathematical analysis of statistics; physiological optics; theories of magnetism; X-ray spectra.

The chairmen of all the special committees operating under the appropriation from the Rockefeller Foundation have made final accounting of their expenditures and have returned to the bursar of the National Research Council all the moneys held by them under this appropriation.

Revolving fund for mathematical publications.—The division has secured an appropriation from the council of an additional $1,000 to be added to the previous appropriation of $500, making a total of $1,500 now available in this fund. Efforts are being made to secure from outside sources a considerable addition to this amount, in order to make possible the publication of certain important mathematical books. Under the fund already provided one book is being published through the agency of the Princeton University Press.

Cooperation with Bureau of Standards.—Arrangements have been made with the Bureau of Standards for loaning to university labora-

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tories for a limited period of time apparatus or parts of apparatus difficult or impossible to obtain quickly, which are not in use at the time at the bureau. It has been arranged that investigators may go to the Bureau of Standards to pursue researches requiring the special facilities of the bureau when conditions are such that the work could not be carried out otherwise without considerable expense or loss of time.

Duplicates in astronomical libraries.—A request has been mailed to the various astronomical libraries in this country asking for lists of duplicate publications held in these libraries, together with information as to which of these duplicates the individual library is willing to sell, loan, or exchange. Complete returns are not as yet in this office, but it is the intention shortly to mimeograph replies to date and distribute, in order to facilitate the sale, loan, or exchange of such duplicate publications.

Collaboration with the research information service.—The division has prepared a code for the findex system and has aided in the findexing of the physicists in the United States.

Dr. F. E. Brasch, chief reference librarian of the James Jerome Hill Reference Library, St. Paul, Minn., is actively engaged in compiling astronomical bibliographies; Dr. J. B. Shaw, of the University of Illinois, is actively engaged in compiling mathematical bibliographies; and Dr. Karl K. Darrow is actively engaged in the preparation of physics bibliographies.

National research fellowships in physics and chemistry.—There are now 15 active fellows in physics and 22 active fellows in chemistry, with definite new appointments of 3 in physics and 6 in chemistry, making a total of 18 in physics and 28 in chemistry. There are, in addition, two applications which have been referred to board members with power upon which no action has as yet been taken.

DIVISION OF ENGINEERING.

[ALFRED D. FLINN, Chairman.]

(For list of members, see Appendix A.)

Meetings of the division were held in New York at Engineers' Club on September 16, 1921, December 9, 1921, February 14, 1922, and April 21, 1922.

The year ending June 30, 1922, saw substantial work done. The fatigue of metals research has yielded definite laws regarding these phenomena. Methods, materials, and equipment for welding have been improved and the establishment of codes and standards advanced. The study of molding sands is beginning to effect economies in the foundries. The advisory board on highway research has done much to make researches more widely useful, to

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romote additional research, and to bring together the public authorities, the technical organizations, and industries interested in the many phases of highway transport. In cooperation with the division of biology and agriculture the important marine piling investigations have been actively begun on all coasts of the country. Several committee reports have been published. The division is more effectively organized.

For each main branch of engineering there is an advisory board or committee of experts from scientific, engineering, and industrial organizations. These advisory committees are available for advice to National Research Council and Engineering Foundation in consideration of proposed projects or of problems arising during a research. These committees do not meet frequently, but appropriate members are consulted by correspondence through the division office. Advisory committees are now functioning in civil, mining and metallurgical, mechanical, electrical, highway, testing, and welding engineering.

Each project undertaken is supervised by a research committee, whose chairman is an authority. Results are published usually in the journal of the engineering society most interested. To stimulate interest in research, executives of industries are invited as guests to division meetings, "business" is condensed, and time given to speaks on timely subjects. Abstracts of addresses and discussions are published in appropriate journals.

Administrative expenses of the division (totaling approximately $8,000 for the year) were paid partly by the National Research Council and partly by Engineering Foundation. Means for research come in general from interested industries, public bodies and organizations, and, including services of staff engineers, laboratory facilities and materials, are estimated to amount to more than $1,000,000 for projects in progress during the past year. To facilitate cooperation with engineering societies and Engineering Foundation, the division has offices in the Engineering Societies Building, New York.

Advisory board on highway research.—This board, established with member organizations in November, 1920, has been actively at work under the directorship of Dr. W. K. Hatt, professor of civil engineering and director of materials testing laboratory in Purdue University, who began his special duties with the board in July, 1921, with headquarters offices in the council's rooms and in the office of the United States Bureau of Public Roads, in Washington. The council's division of engineering, the Bureau of Public Roads, various state highway departments, United States Army, Engineering Foundation, engineering societies, colleges, and industries are cooperating this project. For the staff necessities of the board about $15,000

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were provided for the past fiscal year in addition to services contributed from various sources; for the coming year $30,000 will be necessary.

The director has traveled widely about the country, giving advice, aiding organization of research, and collecting information about researches in progress. Data are accumulating rapidly. The highway research census conducted by the board, for which 40 per cent of returns have been received, discloses that nearly 400 separate research projects are under way. Experimental investigations involving more than a half million dollars are in progress or authorized by Federal and State departments, universities, industries, and other organizations. The director has published a notable outline for a comprehensive national scheme of highway research.

Committee on economic theory of highway improvement.—The economic theory of highway improvement is being studied by a special committee. Traffic surveys, including important elements formerly neglected, are being made on the roads of several States, and will later be thoroughly analyzed. A subcommittee on tractive resistance of roads, supported by the Quartermaster's Department of the United States Army, United States Bureau of Public Roads, the States of Massachusetts and Connecticut, Harvard and Yale Universities, Massachusetts Institute of Technology, American Road Builders' Association, Portland Cement Manufacturers' Association, Society of Automotive Engineers, and various builders of auto trucks, has secured much valuable experimental information, which is now being studied. Efforts of the committee are now being directed to the designing of instruments which will accurately measure various elements entering into the gross tractive resistance of trucks under various conditions.

Marine piling investigations.—Because of the great damage—damage amounting to millions of dollars—to marine piling and other wooden structures in the harbor and bay of San Francisco by "shipworms" (boring mollusks), and at the suggestion of a committee organized in San Francisco in July, 1920, the division of engineering, in collaboration with the council's division of biology and agriculture, established a national committee on marine piling investigations, which has been very active during the past year under the direction of Col. William G. Atwood, formerly of the Engineer Corps of the United States Army. In addition a special port committee has been set up in New York. Funds to support the investigations have been obtained from various interested sources, especially railways with marine terminals. Cooperation in service and otherwise has been obtained from the United States Departments of Commerce, War, and Navy. Cooperation has also been assured by the Canadian Government and railways. The national committee is giving attention to the engineering,

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hemical, and biological phases of the problem of protection. The lirector visited the Pacific coast in May and June and studied closely he results of two years' work by the San Francisco local committee.

American Bureau of Welding.—This bureau acts as a joint advisory oard of the division and the American Welding Society on welding esearch and standardization. It has 10 research committees now t work on various phases of the welding problem, as electric-arc velding, gas welding, resistance welding, welding of storage tanks, velded rail joints, standard tests for welds, etc. All of these committees have been active during the year, and numerous reports of vork accomplished have been prepared and published in standard ngineering journals.

Committee on heat treatment of carbon steel.—This committee has or aim the increase of our now fragmentary knowledge of the influnce of heat treatment on the mechanical properties of carbon steel, nd especially to learn the conditions which most advantageously et up the sorbitic state, the most valuable for engineering purposes. A report embodying the results of much experimental work is now n process of preparation.

Committee on physical changes in iron and steel below the thermal ritical range.—Work is in steady progress by members of the committee or under their direction at the various plants with which they re connected. Materials are contributed by the companies and ested at their laboratories and at the Bureau of Standards. Valuble reports have been recently prepared and published.

Committee on deoxidizers.—This committee is actively investigating the fundamental problems involved in the use of deoxidizers in teel manufacture. Cooperation has been secured from the manufacturers of deoxidizers and is being sought from the steel industry. The first phase of the committee's work is finished, and a report has been published. The second phase is organized and under way.

Committee on Neumann bands.—The committee is investigating he relation (if any) between the speed of rupture of a piece of steel nd the resulting number of Neumann bands, and whether the presnce of Neumann bands in metal is evidence of weakness. The Army and Navy are cooperating. A report by F. B. Foley and S. P. Howell, embodying results and conclusions to date, will be published in August by the American Institute of Mining and Metallurgical Engineers.

Committee on fatigue phenomena of metals.—This is one of the outstanding research committees of the division both from the point of view of the importance of the problem in hand and of the extent of the work actually being done and the financial support obtained for it. The work is in charge of Prof. H. F. Moore, of the University of Illinois, and most of it is done in the laboratories of the engineer-

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ing experiment station of that university, which has provided expert service, laboratory space, and other facilities equivalent in value to about $6,000 a year. Engineering Foundation made a grant of $15,000 a year for two years beginning November, 1919, work under which was completed in October, 1921. In the summer of 1920 the General Electric Co. began to contribute an additional $30,000 to provide for an extension of the work to include 3 to 3½ per cent nickel steel. A comprehensive report on the basis of work accomplished was published in October, 1921, as Bulletin No. 124 of the University of Illinois engineering experiment station and in March, 1922, publication No. 4 of Engineering Foundation. A second report is in preparation. Active progress in work on the fatigue properties of special steels is being made.

Committee on uses of tellurium and selenium.—The committee has determined the amount of tellurium and selenium possible to produce if there were an unlimited market, and has ascertained the present uses. The chairman has discovered an unusual solvent, selenium oxychloride. A comprehensive report setting forth the methods of ore extraction of these elements has been prepared and will probably be published shortly. This report was written because certain investigations indicated that it was possible by use of selenium and tellurium to increase the fuel value of low-grade gasoline, and if such use were made the supply would not equal the demand.

Committee on new hardness-testing machine.—This committee, organized to develop a new machine for testing hardness of metals and other substances with higher capacity than the familiar Brinell apparatus and the scleroscope, has completed its work and summarized it in a paper published in July, 1921, in Mechanical Engineering.

A committee on the general subject of hardness testing of metals has secured cooperation from several Government laboratories, industrial companies, and individuals and is actively at work. Important papers are now being prepared by it for publication.

Committee on steel ingots.—This committee, organized during the war to determine the best open-hearth practice for the manufacture of gun steels and fine steels generally, has completed its work. Its report, offering probably the best specifications for acid open-hearth practice ever made, was published in January, 1922, by the American Institute of Mining and Metallurgical Engineers.

Committee on pulverizing.—This committee for the investigation of fundamental problems connected with pulverizing ores and other materials has secured cooperation from several universities and from the United States Bureau of Mines, which has agreed to assist through members of its staff and to pay one-half of the salary of a man to devote his whole time to the work of the committee. The bureau has requested the committee to act as an advisory commis-

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sion on milling and pulverizing and to select five subjects of investigation for the Bureau of Mines fellows for 1923.

Committee on molding sands.—A project for the devising of better and more economical methods of the use of molding sands was organized under the auspices of the division and has the support of the American Foundrymen's Association and other interested industries. Various research subcommittees are at work on special parts of the general problem, and already thousands of dollars are being saved annually by the foundries of the country by following suggestions of the committee.

Committee on electrical core losses.—This committee is making an effort to reduce the calculation of electrical core losses as well as of eddy-current losses to a more rational and scientifically exact basis. Four phases of the work are now being conducted by four universities—Harvard, Massachusetts Institute of Technology, University of Missouri, Washington (St. Louis)—and by the General Electric Co., under the supervision of five members of the committee. A number of manufacturers are furnishing the services of their engineers and the facilities of their laboratories.

DIVISION OF CHEMISTRY AND CHEMICAL TECHNOLOGY.

[F. G. Cottrell, Chairman.]

(For list of members, see Appendix A.)

The annual meeting of the division was held in Rochester, N. Y., on April 24, 1922.

Critical tables of physical and chemical constants.—One of the most important undertakings in which the division of chemistry is interested is that of the compilation and publication of critical tables of physical and chemical constants. Dr. E. W. Washburn, professor of ceramic chemistry in the University of Illinois, and chairman-elect of the council's division of chemistry and chemical technology for 1922–23, has been appointed editor in chief of the tables, and will have as chief assistants an associate editor for chemistry and one for physics. Satisfactory relationships have also been worked out between the Annual Tables of Constants, edited by Dr. Charles Marie at Paris, and the Critical Tables, whereby all the material, both published and unpublished, which has been or is being gathered by the former board is made immediately available for the use of the latter, thus obviating duplication and delay. It should here be recalled that both the Annual and the Critical Tables are clearly recognized as international undertakings and as such have been taken under the official patronage of the International Union of Pure and Applied Chemistry and the International Research Council, but the primary responsibility for seeing to their successful carrying out is intrusted,

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respectively, to France in the one case and the United States in the other. The Annual Tables are much the older project of the two, having been issued ever since 1910, thus antedating the formation of the Union of Pure and Applied Chemistry and the International Research Council themselves, while the project of the Critical Tables had its inception at the first meeting of these two bodies in 1919.

The Annual Tables aim to collect and publish all determinations of physical and chemical constants which have appeared anywhere during the year but without attempt to compare, weigh, or combine any of these data. The Critical Tables, on the other hand, aim to review all available data on each constant and from these determine and publish the most probable value deducible therefrom.

Although the general administrative work with regard to both these tables of constants has been more closely associated with the division of chemistry than any other of the technical divisions of the council, it must be fully realized that other divisions, especially physics, engineering, and biology and agriculture, are largely, if not equally, concerned in the results. In recognition of this fact, the advisory committee to American commissioner of International Commission on Annual Tables and Numerical Data has been transferred from the division of chemistry and chemical technology to be a committee of the executive board of the National Research Council, and thus coordinate with the trustees and the editorial board of the Critical Tables, both of which have always reported directly to the executive board.

Committee of ceramic research.—This is a joint committee representing the division and the American Ceramic Society. It has outlined for the coming year four chief topics for its activities, namely: (1) Study of the elements which determine the plastic nature of clay; (2) a critical examination of certain methods used in silicate analysis; (3) a study of the American pot clays and their proper compounding for the production of refractories used in the glass industry; and (4) a study of the relationship between crazing and the expansion coefficients of bodies and glazes.

Committee on chemistry of colloids.—This is one of the most widely active and productive committees of the division. A symposium on colloids was held at the Birmingham meeting of the American Chemical Society. The chairman of the committee has published a laboratory manual on the chemistry of colloids and has completed a bibliography of about 1,600 references which is now ready for publication. The committee has been instrumental in arranging for lectures on colloid chemistry by specialists at various universities and scientific and technical society meetings throughout the country and has done much to stimulate attention to the opportunities for work in this field in the regular courses of universities and technical schools.

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Committee on contact catalysis.—The first report of this committee has just appeared in four successive numbers of the Journal of Industrial and Engineering Chemistry (April, May, June, and July, 1922) and will be reprinted as No. 30 of the council's reprint and circular series. Material for a further report is being assembled.

Committee on methods of organic analysis.—The manuscript for the fourth volume of Prof. S. P. Mulliken's Method for the Identification of Pure Organic Compounds was sent to the printer in October, 1921, but publication has been delayed by printing difficulties. It is expected that the volume will appear this summer. It includes characterization of 3,700 organic compounds belonging to 14 combinations of the elements.

Committee on preparation of list of research chemicals.—This is a joint committee representing the division and the research information service. A revised edition of its first report (issued in September, 1921, as No. 23 of the council's reprint and circular series) was issued in June, 1922, as No. 35 of the same series. This publication lists 80 firms in the United States representing the manufacture of research chemicals. The chemicals listed number about 2,000.

Committee on sewage disposal.—This committee having found it impracticable under existing conditions to carry out the program originally contemplated has been allowed to lapse.

Committee on publication of war data and information.—This is a joint committee representing the division of chemistry and the division of Federal relations. The committee has succeeded in securing the release for publication of several Government documents containing important data and information concerning war problems. A sympathetic attitude on the part of both the War and Navy Departments exists with respect to the publication of nonconfidential matter, but progress in the publication of this matter must necessarily be slow

Committee on explosives investigations.—This committee, under the chairmanship of Dr. Charles E. Munroe, has been one of the most active committees of the division and has completed a great deal of work during the last year. Based on the activities of this committee, more than a dozen papers have been completed and published during the year and several other papers are completed and ready for the printer, while a few others are in an advanced state of preparation. The special subjects of the committee's activities are: Development of Neumann bands in metal subjected to the action of explosives of known characteristics; utilization of surplus military explosives; physical constants of TNT, TNA, picric acid, and tetryl; the development of insensitiveness in cordeua detonant and TNT with age; water storage of explosives; burning of explo-

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sives, particularly in large quantities; premature explosions in oil-well shooting; menace in storing carbide with explosives; danger in use of low-grade detonators; analytical methods as applied to explosives; explosions by influence; deterioration of mercuric fulminate; nitrate fires; utilization of surplus detonating devices; the explosibility of ammonium compounds.

National Research fellowships in physics and chemistry.—There are now 22 active fellows in chemistry and 15 active fellows in physics, with definite new appointments of 6 in chemistry and 3 in physics, making a total of 28 in chemistry and 18 in physics. There are, in addition, two applications which have been referred to board members, with power, upon which no action has as yet been taken.

DIVISION OF GEOLOGY AND GEOGRAPHY.

[EDWARD B. MATHEWS, Chairman.]

(For list of members, see Appendix A.)

The annual meeting of the division was held in Washington on April 21 and 22, 1922.

Government board of surveys and maps.—The division has continued its interest during the last year in the development of the United States board of surveys and maps, which represents the type of co-operative scientific undertaking in which the council is particularly interested. This board was established on December 31, 1919, by Executive order after the presentation of memorials and consideration of plans by the National Research Council, Engineering Council, and other organizations interested in the map-making activities of the Federal Government. The number of Federal bureaus now represented on the board is 18, and the public is represented by an advisory council of 21 selected from various engineering, scientific, and other organizations interested in the manufacture and use of maps. The chairman of the council's division of geology and geography has been chairman of this advisory council from its inception.

Investigation of glacial clays.—At the request of the division, the council appropriated $500 for cooperative support of an investigation of glacial chronology by Dr. Ernst Antevs through the detailed study of laminated clays. With the help of this fund Doctor Antevs was able to continue his field work and establish type sections across New England and northern New York. Through the assistance of the Carnegie Institution of Washington he will be enabled to extend his investigations to the clays of the extinct Lakes Bonneville and Lahontan in the Great Basin.

Bibliographies.—The project of securing a list of unpublished bibliographies on geology and geography has been accomplished, and the list published as No. 27 of the council's reprint and circular series.

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The project, instituted conjointly with the research information service, to bring up to date de Margerie's Bibliography of Geological Bibliographies, which appeared about 25 years ago, has been practically completed. After an exhaustive search through the geological literature, including the complete files of over 300 periodicals, a list of about 4,000 entries has been made and cross indexed and the manuscript is ready for the press. The need of this compilation and publication has been called to the attention of the division by numerous working geologists.

Committee on sedimentation.—The work of the division's committee on sedimentation has enlisted more cooperation and more enthusiasm on the part of the workers than any other of the division's undertakings. This committee has enlisted the services of geologists of many special interests, as oceanographic, petrologic, geophysical, stratigraphic, and economic, together with men from other sciences representing interest in the biologic, pedologic, and physical-chemical phases of the sedimentation problem.

The committee has recently submitted to the division a report in which are presented by various members outlines of studies in sedimentation being carried on in the universities, problems suggested by State geologists, a review of investigations being carried on by Federal institutions, a bibliography of chemical and physical researches, an outline of the field descriptions and suggestions for color charts for sedimentary rocks and a full outline for a general treatise on sedimentation. Several geologists not members of the committee collaborated with the members in the preparation of this report.

In addition the committee has been able in several instances to bring about cooperative research by two or more organizations on problems which no single one of them would, or perhaps could, have undertaken alone. It has also helped through correspondence and conference various isolated workers who have sought advice. It is interesting to note that all of the work of this important and successful committee has been accomplished without special funds.

Committee on geography.—The division organized a committee to consider the best methods of assisting in the development of geographical sciences in America. It has had under its supervision the special work of preparing for publication certain geographical data accumulated in preparation for the Peace Conference at Versailles. This has included especially the preparation of soil vegetation, land classification, and rainfall maps of America. With the special assistance of Messrs. C. F. Marbut, H. L. Shantz, and J. B. Kincer, the manuscript text has been edited and is now ready for publication. It will appear probably in October, 1922. This work has been done in cooperation with the American Geographical Society and involved the financial cooperation of this society and the council.

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This committee has also undertaken a number of other cooperative projects. One of the most important developments of the year in connection with the committee's work is the close cooperation which has been set up between the committee and the educational committee of the Association of American Geographers. Through this cooperation several definite plans for facilitating geographical research have been formulated.

Miscellaneous activities.—Recently the division of States relations requested the assistance of this division in a study of the organization of the work of State geological surveys, especially as regards research in cooperation with other agencies. This compilation has been completed and was presented to the division of States relations at its annual meeting on May 23.

Through the cordial relations which have been set up between the division and the Military Intelligence Division of the Army, a number of Russian general staff maps were secured for use of the important Roy Chapman Andrews expedition to Mongolia in the interests of the American Museum of Natural History.

A lengthy list of books on geology and geography was supplied to the newly opened James Jerome Hill Reference Library, of St. Paul. In the preparation of this list the division had the collaboration of the American Geographical Society and the National Geographic Society.

DIVISION OF MEDICAL SCIENCES.

[V. C. VAUGHAN, Chairman.]

(For list of members, see Appendix A.)

The annual meeting of the division was held in Washington on April 24, 1922.

Fellowships in medicine.—The most important new undertaking of the division during the last year has been its assumption of the responsibility of administering an appropriation, made jointly by the Rockefeller Foundation and the General Education Board, of $500,000, to be expended through five years at a rate of not more than $100,000 a year, for the maintenance of fellowships in medicine. The immediate administration of the fellowships has been placed in the hands of a special board, selected by the division, of eight men eminent in medical investigation and teaching, of which board the chairman of the division is ex officio chairman.

The following general statement has been made by the board to indicate the special purpose of the fellowships and the conditions under which they will be awarded:

(*a*) The chief purpose of these fellowships is to fit men and women for teaching in medical schools; (*b*) all branches of medicine, both preventive and curative, shall be open to those who seek the fellowships; (*c*) the fellowships are open to citizens of

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both sexes of the United States and Canada; (*d*) applicants must have an M. D. or a Ph. D. degree or qualifications equivalent to that indicated by the possession of one of these degrees; (*e*) the stipend is to be determined by the medical fellowship board in each individual case; (*f*) the fellowships are not granted to institutions, and the fellow elects, with the approval of the board, the place where and the man or men under whom he will do his work.

Up to June 30, 1922, 13 fellowships had been awarded.

Research on sex problems.—At the invitation of the Bureau of Social Hygiene, the division interested itself in the matter of organizing a series of scientific investigations relating to fundamental sex problems in the fields of morphology, physiology, and psychology. With the financial aid of a gift of $1,000, a conference of a dozen competent scientific men and women interested in such problems was held in the council's rooms in Washington on October 29, 1921. This conference recommended that investigations relating to these problems be undertaken under the auspices and general direction of the division of medical sciences of the council with the cooperation of the Bureau of Social Hygiene, and that a permanent board be set up by the division to have immediate charge of the investigations. Mr. John D. Rockefeller, jr., offered to make available to the special board, through the council, the sum of $25,000 to meet the expenses of these investigations during the year July 1, 1922, to June 30, 1923. Such a board was accordingly organized, consisting of the following specialists: Dr. W. B. Cannon, professor of physiology in Harvard Medical School; Dr. E. G. Conklin, professor of zoology, Princeton University; Dr. Katherine B. Davis, of the Bureau of Social Hygiene; Dr. T. W. Salmon, of the Society of Social Hygiene and professor of psychiatry in the College of Physicians and Surgeons, Columbia University; and Dr. R. M. Yerkes, of the National Research Council, and some time professor of psychology in Harvard University. Doctor Yerkes was made chairman of the board and Mr. Earl F. Zinn, of the Bureau of Social Hygiene, was appointed a salaried full-time executive secretary of the board.

Study of goiter.—In September, 1921, the chairman of the division began to abstract the literature in the Surgeon General's library bearing on the prevalence and distribution of goiter in North America. This abstract as far as completed is now in the records of the division. An arrangement was made with Surgeon General Ireland by which charts and maps showing the percentage of rejections from Army service in the draft districts of various States for (*a*) simple goiter, (*b*) exophthalmic goiter were prepared. Prof. David R. Hall, of the University of the State of Washington, has supplied the division with a map of that State giving the distribution of goiter by counties as indicated by the examination of students entering the university. The division now has in its records three maps of the State of Washing-

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ton indicating interesting facts with regard to the occurrence of goiter in that State. Map No. 1 gives the distribution of goiter among students, male and female, of an average age of 20 years, as distributed among the different counties of the State. Map No. 2 gives the percentage of rejections for simple goiter in the draft during the World War in the different draft districts of the State. Map No. 3 gives the same distribution for exophthalmic goiter. The division has asked the council to authorize the appointment of a special commission to prosecute further this study.

Tuberculosis death certificates in Colorado.—In December, 1921, the council, on recommendation of the division, appropriated $1,000 to be used by the Denver Sanatorium Association in a study of the death certificates of persons dying from tuberculosis in Colorado during the past 12 years. This work is being prosecuted under the immediate direction of Dr. Henry Sewall, of Denver. The object of this study is to make some contribution toward a solution of the important problem of the relation of climate to tuberculosis. If the present study in Colorado gives indications of apparent value, it is proposed to carry on similar investigations in other parts of the country.

Study of heart disease.—At the suggestion of Drs. Lewis A. Conner and Alfred E. Cohn, the division called a special meeting of its executive committee to consider, in collaboration with Doctors Conner and Cohn, a plan of research proposed by the Association for the Prevention and Relief of Heart Disease. This plan has as principal features the following: (*a*) To clarify phases in the incidence, etiology, and therapeutics of heart disease; (*b*) to obtain data for an economic bearing in patients suffering from clinical heart disease; (*c*) to afford opportunity for the study of certain clinical problems. The plan as proposed calls for a budget of $18,000 to be expended in the next 12 months. This plan was approved by the division and steps have been taken to secure the funds necessary for its carrying out.

Vestibular research.—In collaboration with the divisions of anthropology and psychology and of biology and agriculture, the division of medical sciences has taken part in the general direction of a research, called vestibular research, looking toward the solution of certain problems in aviation, which problems require for their solution an accurate analysis of the functions of equilibrium. The direction of the investigations is under the immediate charge of a special committee consisting of Dr. J. Gordon Wilson, professor of otology, Northwestern University, chairman; Dr. Raymond Dodge, professor of psychology, Wesleyan University; Dr. F. H. Pike, associate professor of physiology, University of Chicago; and the chairmen of the council's divisions of anthropology and psychology and of biology and agriculture and of medical sciences. The work

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already accomplished in this research and the work under way are explained later in this report under the discussion of the activities of the division of anthropology and psychology.

Study of the relation between atmosphere and man.—This is an investigation carried on with the collaboration of the division of biology and agriculture. In January, 1922, a special committee was appointed, consisting of Dr. Ellsworth Huntington, research associate in geography, Yale University, chairman; J. Arthur Harris, botanical investigator, Station for Experimental Evolution, Carnegie Institution; C. E. McClung, professor of zoology, University of Pennsylvania; Raymond Pearl, professor of biometry and vital statistics, Johns Hopkins University; L. R. Jones, professor of plant pathology, University of Wisconsin; and the chairman of the division; as a result of which, investigations have been set under way through the cooperation of various factories and with financial support from various sources.

Standardization of biological stains.—This is a project being carried on primarily under the general direction of the division of biology and agriculture, but in which the division of medical sciences has been asked to cooperate. A special committee was appointed composed of Dr. H. J. Conn, associate bacteriologist, agricultural experiment station, Geneva, N. Y., chairman; S. I. Kornhauser, professor of zoology, Denison University; F. B. Mallory, pathologist, Boston City Hospital; F. G. Novy, professor of bacteriology, University of Michigan; and L. W. Sharp, assistant professor of botany, Cornell University. Doctors Mallory and Novy are special representatives of the division on this committee. Certain investigations in connection with this general project have been actively carried forward and preliminary reports of results published. Other details concerning this investigation will be found later in this report under the discussion of the activities of the division of biology and agriculture.

DIVISION OF BIOLOGY AND AGRICULTURE.

[L. R. Jones, Chairman.]

(For list of members, see Appendix A.)

The annual meeting of the division was held in Washington April 22, 1922.

This division has undertaken an exceptionally large number of projects, of which a classified list indicates that 7 may be looked on as completed and 25 as under way. In addition three new ones are projected and several others have been submitted for consideration.

Federation of biological societies.—One of the most interesting and important recent activities of the division has been in connection with a proposed federation of national biological societies for the

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purpose of bringing to bear the combined attention and influence of all American working biologists, who are estimated to be at least 6,000 in number, on undertakings of importance and common interest to all these biologists. An example of such possible and needed undertakings is the much-discussed one of an improvement in publication facilities and the development of a journal for biological abstracts, to cover all biological journals and miscellaneous publications, both American and foreign. Progress in connection with this federation has been active and positive. Under the sponsorship of the council and division, two conferences have been held during the year, one at Toronto in December, 1921, and one at Washington in April, 1922. At the Washington conference accredited representatives of 18 national biological societies and of the 4 biological sections of the American Association for the Advancement of Science were present. At this conference arrangements were made for setting up a council of the federation consisting of two representatives of each society and the appointment by this council of an executive committee. A special joint committee on publications, representing the federation and the council's division of biology and agriculture was provided for.

Botanical abstracts.—The council at the recommendation of the division has, in addition to making certain grants of money, arranged to bring the bibliographic and editorial office of botanical abstracts to Washington, giving its office housing space in the council's rooms and providing for editorial and clerical assistance for 18 months beginning February 1, 1922. Dr. J. R. Schramm, editor of Botanical Abstracts, gives part of his time to work as scientific associate of the research information service and as executive secretary of this division.

Forestry projects.—The projects of this division relating to forestry, which are under the immediate administration of the special committee on forestry, have been pushed actively during the past year. Work on reforestation of cut-over lands and improved methods of silviculture have been carried on in 10 Southern States. This work will probably be concluded in the fall of 1922, and the field data worked up to form a report. Arrangement has been made for publication of a remarkable collection of international forestry statistics by the McGraw Hill Book Co.

Sulphur fellowships.—At the recommendation of the division, the council has accepted a gift from the Texas Gulf Sulphur Co. of $10,000 to be used for the maintenance of a series of research fellowships for studies on the agricultural uses of sulphur. Eight such fellowships have been established and appointments made for most of them.

Sigma Xi fellowships.—As a result of a small grant made by the council to the Sigma Xi Society in 1921 to promote its endeavors to

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establish research fellowships in biology, funds have been secured by the society enabling it to offer several fellowships at a minimum of $1,600 each.

Standardization of biological stains.—This work is directed by a special committee representing the division, the Society of American Bacteriologists, Botanical Society of America, and American Society of Zoologists, together with representatives of the medical sciences. The work has been in active progress under the direction of Dr. H. J. Conn, of Geneva, with the aid of a grant of $1,000 from the Chemical Foundation. (See also under division of medical sciences.)

Biological relations of insects to flowers.—An investigation of the biological relations of insects to flowers, through the cooperative efforts of the division, the American Museum of Natural History, Cornell University, and the University of Colorado, has been undertaken and field work is now in progress in Colorado. The investigators include botanists, entomologists, and physicists.

Advisory board of the American Institute of Baking.—Closer cooperation between the American Institute of Baking and an advisory board set up at its request by the division has been established during the year. Under the supervision of Doctor Prescott, of the board, a study of mold infection of breads has been undertaken in his laboratory at the Massachusetts Institute of Technology. During the past year the institute has transferred its headquarters from Minneapolis to Chicago. One of its chief aims is to enlist the interest of graduate students in chemistry in the possibility of devoting their energy to problems of technical interest to the baking industry. Cooperative relations have already been established by the institute with several universities.

Food and nutrition projects.—One of the main pieces of work developed under the auspices of the committee on food and nutrition is that on the calcium of magnesium metabolism in women undertaken under the direction of Dr. Jean Bogert at the Kansas State Agricultural College. The work which was being done in animal nutrition under the supervision of the late Dr. H. P. Armsby, at Pennsylvania State College, is being continued under the direction of Prof. E. B. Forbes, of the same college. Preliminary results have already been published in the bulletin series of the council.

A special undertaking in connection with food-products investigation with the aid of funds donated by the Glass Container Association of America is an investigation of proper methods for determining the number and character of contaminating microorganisms affecting food products. Part of the work has been developed under the direction of Dr. R. S. Breed, of the Geneva Agricultural Experiment Station, and a report on this work is now being prepared for publication.

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Investigations on the atmosphere and man.—With some financial support from the council, used especially for development and promotion work, the committee on atmosphere and man has been able to find additional financial support and to effect cooperative relations with various factories in which it is proposed to make investigations of the relation of atmosphere to the efficiency of the workers. Some of this work is already under way. (See also under division of medical sciences.)

Catalogue of unpublished bibliographies in biology.—Active work has been under way for several months on the preparation of a catalogue of unpublished bibliographies in biology.

Contagious abortion.—In connection with the contagious abortion project, a project undertaken jointly with the division of medical sciences, a committee has been appointed to coordinate the activities of the cooperating workers, including veterinarians, bacteriologists, etc., on this investigation.

Rust project.—The project for the bringing to completion, under the sponsorship of the division, of Dr. J. C. Arthur's important monograph on the North American rusts has enlisted the cooperative efforts of the United States Department of Agriculture, Purdue University, Pennsylvania State College, and Virginia Polytechnic Institute. A representative from each of these State institutions is to cooperate with Dr. Arthur in advancing this work.

Marine piling investigations.—This project, undertaken by the joint efforts of the division and the division of engineering, is one of the large projects of the council and is actively under way. (For special reference to it see division of engineering in this report.)

Conferences.—The division lays special stress upon the value of conferences on important biological problems and it has sponsored a number of these conferences during the year, notably a conference on biophysical problems, a genetics conference, a conference on contagious abortion, and conferences dealing with a federation of American biological societies. Certain of these conferences have already been referred to in connection with the special projects of the division.

DIVISION OF ANTHROPOLOGY AND PSYCHOLOGY.

[CARL E. SEASHORE, Chairman.]

(For list of members, see Appendix A.)

The annual meeting of the division was held in Washington on April 25, 1922.

Conference on anthropological problems.—On September 24, 1921, a conference of distinguished specialists, including psychologists,

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medical men, and general biologists, was held in New York to consider the question:

From the point of view of applied racial psychology and anthropology to-day, what are the most timely and promising scientific projects of a basic nature that the division of anthropology and psychology of the National Research Council should attempt to formulate and foster?

A considerable variety of suggestions was made, of which five were generally approved for special consideration and active attention by the division, as follows:

1. The formulation of a procedure for the testing of fitness of prospective immigrants through the consulates of the various countries sending in immigrants on the 5 per cent basis. If there is to be a selection, there is no reason why we should not establish a preferential list, where more than the 5 per cent quota apply, and establish important minimum standards within the quota.

2. A consideration of the needs of vital statistics on the mental side of man for the purpose of encouraging census authorities and various voluntary organizations to insert certain desired items in their census or surveys, and to establish uniform procedure in the collection of these data.

3. The specification and standardization of the basic mental tests that should be observed, measured, and recorded in the comparison of races and other social groups. At the present time there is no consensus of opinion as to which traits are most significant, and there is no well-established technique of procedure.

4. The inheritance of mental traits: This is involved in many projects, and it may be well to give directions to a number of interests working in this field at the present time.

5. A review of the motives and mental conditions that tend to produce crime in this country, the object being to reveal the importance of the instinctive intellectual and mental forces which may be employed in the suppression of crime and the reduction of social unrest.

Committee on State archæological surveys.—The work of this committee during the year falls under two main heads: (1) Developing a plan for surveys in the Mississippi Valley and the formulation of technique for field work, and (2) the stimulation of activities in the several States. The committee has been able to arrange for the starting of surveys in Indiana, Iowa, and Missouri. The outlook is good for the initiation of a survey in Illinois. Other States are being approached. A handbook on State archæological surveys is being prepared by the committee.

Psychological abstracts.—The division has had for some time a committee on the initiation of a journal of psychological abstracts. In the light of the development of the plan for establishing a national federation of biological societies (see under division of biology and agriculture) and the probable founding by this federation of a journal of biological abstracts, the division has discharged this committee and set up a special committee on psychological abstracts for the purpose of cooperating with the federation of biological societies in order to standardize abstracts, encourage journals to require and

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print authors' abstracts, and develop a single cooperative agency through which all biological (including psychological) abstracts shall be published.

National intelligence tests.—The work during the past year of this important committee—whose earlier work resulted in the preparation of a set of national intelligence tests for school children, published and distributed by hundreds of thousands to the schools of the country by the World Book Co., of Yonkers, N. Y.—has been largely routine. Through the World Book Co. the committee issued in May, 1921, a supplement to the manual of directions and later in the summer a revised edition. All royalties arising from these publications are devoted to financing the further work of the committee.

Material has been collected for the establishment of norms and the revision of old norms, taking into account geographical distribution, sex difference, and practice and methods of converting scores into "mental age" scores.

College entrance tests.—The division has set up a committee on college entrance tests, which is instructed to prepare for publication an annual survey of the subject.

Superior attainment of college students.—In collaboration with the division of educational relations the chairman of the division has taken an active part in planning and carrying on a special study of the problem of the college and university student of superior attainment, or the "gifted student," as he has been called. In this connection the chairman has written an "open letter to college seniors" calling attention to the opportunities open to competent students for careers in scholarship and research. Over 15,000 copies of this "open letter" have been provided college deans and special faculty committees, at their specific request, for distribution to members of graduating classes. The chairman has also prepared a bulletin on "Psychology as a career" and another on "The sectioning of classes on the basis of ability," both of which have been given a wide circulation. Dr. Clark Wissler, curator of anthropology in the American Museum of Natural History and member of the division, has prepared a bulletin on "Anthropology as a career," which has been published. (For further account of the work of the council in connection with the problem of the gifted student see Division of Educational Relations in this report.)

Committee on vestibular research.—The committee on vestibular research, a joint committee of three divisions of the council, of which the division of anthropology and psychology is one, is unusual in character by reason of the fact that each member of the committee is personally actively engaged in cooperative research on the problem before the committee. The special efforts of the committee are

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directed toward a solution of the problem of animal equilibrium, especially the equilibrium of aviators. The reputed relation of the vestibule of the ear, including the semicircular canals, to equilibrium directs the work of the committee largely toward an investigation of this vestibule, and hence gives the committee its name.

One of the main problems of flying is the problem of balancing in the air. The factors which enter into balancing are complex and but partially known. Three known factors are recognized, the eye, the ear, the joint, muscle, and pressure sensations. Excessive stimuli from at least two of these, the eye and the ear, will result in vertigo. Any or all of these factors may give faulty information, which would tend to produce faulty control of the machine and possible disaster. The causes of this false information are known only in part. Faulty reactions while flying may also come from temporary pathological causes; for instance, blockage of the tube to the ear. These, if recognized, could be guarded against.

Statistics published by the United States War Department show that 96 per cent of fatalities during flying were due to faults or circumstances directly connected with the pilot, circumstances connected with an uncorrected maneuver, or a loss of control.

The purpose of this committee is not only to study the factors which enter into balancing but to study the factors which disturb this balance, and, if possible, to ascertain how to rectify such errors. Since certain individuals have their balance easily upset, the committee would study which particular factor or factors are at fault.

The researches of the committee are actively under way. Certain financial support has been given the committee by the council. (See also under Division of Medical Sciences.)

Immigration problems.—As a result of correspondence initiated by Dr. Robert DeC. Ward, of Harvard, informal conferences have been held with persons interested in the scientific approach to the problem of selective immigration, and there seems to be general agreement that a conference on this subject should be called early in the fall. This conference might meet in two divisions: First, a general conference made up of representatives of those in charge of the immigration examinations, Doctor Pierce, the Commissioner of Immigration, and the chairman of the Immigration Committees in the Senate and House, respectively, Professor Yerkes, Doctor Ward, and the chairman of this division. The object of this preliminary conference should be to establish cordial relations with those who are charged with the administration of the service. This might then be followed up by the organization of a smaller committee to consider the technical work of surveying methods of examination, aims and principles of selection, and cooperation with those engaged in the promotion of legislation.

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Committee on stabilizing of scientific funds.—The chairman of the division has given much time during the year to the general problem of ways and means of encouraging and safeguarding funds for research. The history of permanent endowments for charity and science is tragic, in that most of the charters have been the creations of chance or some freakish notion which renders the purpose to be served impracticable and the custody of the funds unsafe. All this is very discouraging to those who desire to set aside money on a large scale in the interest of science. It is therefore clear that the National Research Council has a very important duty and responsibility for the undertaking of thorough investigations of the history of methods of organizing funds, the legal aspects, and methods of popularizing and promoting this interest in a business-like manner for the encouragement of gifts, their establishment on sound business principles, and their designation for permanently useful purposes.

One of the results of the chairman's study of this problem is a tentative proposal called "The elector plan for the administration of research funds," prepared by him personally with the advice of the committee on the subject consisting of President James R. Angell, Dr. Simon Flexner, and Dr. Charles D. Walcott.

Cooperation with other divisions.—In addition to the cooperation of the division with other divisions of the council on projects already mentioned, the division has cooperated with the divisions of medical sciences and biology and agriculture in two other projects, namely: Scientific research in problems of sex (see division of medical sciences in this report) and the relations of atmosphere and man (see division of biology and agriculture in this report).

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APPENDIX A.

OFFICERS, MEMBERS, AND COMMITTEES.

OFFICERS AND EXECUTIVE BOARD.

OFFICERS.

Honorary chairman, George E. Hale, director, Mount Wilson Observatory, Carnegie Institution of Washington, Pasadena, Calif.

Chairman of the executive board, John C. Merriam, president, Carnegie Institution of Washington, Washington, D. C.

First vice chairman, Charles D. Walcott, secretary, Smithsonian Institution; president National Academy of Sciences, Washington, D. C.

Second vice chairman, Gano Dunn, president, J. G. White Engineering Corporation, 43 Exchange Place, New York City.

Third vice chairman, R. A. Millikan, director, Norman Bridge Laboratory of Physics, California Institute of Technology, Pasadena, Calif.

Permanent secretary, Vernon Kellogg, National Research Council, Washington, D. C.

Assistant secretary, Albert L. Barrows, National Research Council, Washington, D. C.

Assistant secretary, Paul Brockett, assistant secretary, National Academy of Sciences, Washington, D. C.

Treasurer, F. L. Ransome, geologist in charge, section of metalliferous deposits, United States Geological Survey; treasurer, National Academy of Sciences, Washington, D. C.

By reciprocal arrangement with the Engineering Foundation—

Assistant secretary, Alfred D. Flinn, secretary, Engineering Foundation; chairman, division of engineering, National Research Council, 29 West Thirty-ninth Street, New York City.

EXECUTIVE BOARD.

Chairman, John C. Merriam.

MEMBERS EX OFFICIO.

Officers of the council (except assistant secretaries).

President of the National Academy of Sciences, Charles D. Walcott, secretary, Smithsonian Institution, Washington, D. C.

Home Secretary of the National Academy of Sciences, C. G. Abbot, director, Astrophysical Observatory, Smithsonian Institution, Washington, D. C.

President of the American Association for the Advancement of Science, J. Playfair McMurrich, professor of anatomy, University of Toronto, Toronto, Canada.

Past chairman of the National Research Council, James R. Angell, president, Yale University, New Haven, Conn.

Chairmen of the divisions of general relations.

Chairmen and vice chairmen of the divisions of science and technology.

MEMBERS AT LARGE.

Edward Dean Adams, engineer, 71 Broadway, New York City.

John J. Carty, vice president, American Telephone & Telegraph Co., 195 Broadway, New York City.

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Gano Dunn, president, J. G. White Engineering Corporation, 43 Exchange Place, New York City.

William M. Jardine, president, Kansas State Agricultural College, Manhattan, Kans.

R. A. Millikan, director, Norman Bridge Laboratory of Physics, California Institute of Technology, Pasadena, Calif.

A. A. Noyes, director of chemical research, California Institute of Technology, Pasadena, Calif.

Raymond Pearl, professor of biometry and vital statistics, Johns Hopkins University, Baltimore, Md.

M. I. Pupin, professor of electromechanics, Columbia University, New York City.

S. W. Stratton, director, United States Bureau of Standards, Washington, D. C.

Ambrose Swasey, president, Warner & Swasey Co., Cleveland, Ohio.

William H. Welch, director, school of hygiene and public health, Johns Hopkins University, Baltimore, Md.

President, Sigma Xi Society, ex officio, Henry B. Ward, professor of zoology, University of Illinois, Urbana, Ill.

Administrative Committees of the Council.

Committee on budget (joint committee with National Academy of Sciences): Chairman, Charles D. Walcott; John C. Merriam, F. L. Ransome.

Committee on building plans: Chairman, George E. Hale; Gano Dunn, H. E. Howe, Vernon Kellogg, John C. Merriam, R. A. Millikan, A. A. Noyes, Augustus Trowbridge, Charles D. Walcott, with H. S. Pritchett in an advisory capacity, representing the Carnegie Corporation.

Committee on building stone (with reference to new building): Chairman, Charles D. Walcott; Vernon Kellogg, John C. Merriam.

Committee on finance: Chairman, John C. Merriam; John J. Carty, Gano Dunn, H. G. Gale, George E. Hale, H. E. Howe, Vernon Kellogg.

Committee on organization and budget: Chairman, H. E. Howe; Vernon Kellogg, F. L. Ransome.

Promotion committee: Chairman, H. E. Howe; Paul Moore.

Committee on publication and publicity: Chairman, Robert M. Yerkes; H. E. Howe, Vernon Kellogg, John C. Merriam.

Representatives of the Council on—

Editorial board of the Proceedings of the National Academy of Sciences: F. G. Cottrell, Alfred D. Flinn, H. G. Gale, L. R. Jones, Vernon Kellogg, E. B. Mathews, John C. Merriam, R. A. Millikan, F. L. Ransome, C. E. Seashore, V. C. Vaughan, Robert M. Yerkes; member of editorial executive committee, Vernon Kellogg.

Board of trustees of science service: George E. Hale, Vernon Kellogg, Robert M. Yerkes.

Commission of Swiss Natural Science Association for the Management of the Concilium Bibliographicum: Vernon Kellogg.

Technical Committees of the Council.

Committee on Concilium Bibliographicum: Chairman, Vernon Kellogg; L. R. Jones, J. R. Schramm, Robert M. Yerkes.

Committee on conservation of natural resources (acting as the Research Council section of the executive committee on natural resources of the American Association for the Advancement of Science, the National Academy of Sciences, and the National Research Council): Chairman, John C. Merriam; J. McKeen Cattell, John M. Clarke, Vernon Kellogg, C. E. McClung.

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Committee to consider various phases of industrial research: Chairman, Gano Dunn; Comfort A. Adams, John J. Carty, George E. Hale, H. E. Howe.

Committee on cooperation with Research Corporation: Chairman, F. G. Cottrell; H. E. Howe, Augustus Trowbridge, Robert M. Yerkes.

Committee on Federal grants for research: Chairman, Vernon Kellogg; John J. Carty, Gano Dunn, S. W. Stratton, Charles D. Walcott, Robert M. Yerkes.

Committee on filing of sealed documents: Chairman, Paul Brockett; F. G. Cottrell, H. E. Howe.

Committee on Patent Office: Chairman, L. H. Baekeland, honorary professor of chemical engineering, Columbia University; residence, Yonkers, N. Y.; secretary, Edwin J. Prindle, 111 Broadway, New York City; W. F. Durand, Thomas Ewing, Frederick P. Fish, Reid Hunt, R. A. Millikan, M. I. Pupin, S. W. Stratton, C. P. Townsend.

Trustees for the publication of International Critical Tables: Chairman, George P. Adamson, president, General Chemical Co., 25 Broad Street, New York City; secretary, W. M. Corse; H. E. Howe, Edward P. Hyde, Hugh K. Moore, Charles L. Reese, Julius Stieglitz.

Editorial board for publication of International Critical Tables: George K. Burgess, Saul Dushman, John Johnston, C. E. K. Mees, C. E. Mendenhall, R. B. Moore.

Executive committee of the American Geophysical Union: Chairman, William Bowie, Chief, Division of Geodesy, United States Coast and Geodetic Survey, Washington, D. C.; vice chairman, Louis A. Bauer, director, department of terrestrial magnetism, Carnegie Institution of Washington, Washington, D. C.; secretary, W. J. Humphreys, professor of meteorological physics, United States Weather Bureau, Washington, D. C.; F. G. Cottrell, Arthur L. Day, H. G. Gale, L. R. Jones, G. W. Littlehales, C. F. Marvin, E. B. Mathews, R. A. Millikan, H. F. Reid, H. S. Washington.

DIVISIONS OF THE COUNCIL.

Division of Federal Relations.

Chairman, Charles D. Walcott.
Vice chairman, A. P. Davis.
Secretary, H. G. Gale.

EXECUTIVE COMMITTEE.

Chairman, Charles D. Walcott; vice chairman, A. P. Davis; secretary, H. G. Gale; William Bowie, Brigadier General A. A. Fries, S. W. Stratton.

MEMBERS OF THE DIVISION.

H. G. Gale, professor of physics, University of Chicago; chairman, division of physical sciences, National Research Council, Washington, D. C.

EX OFFICIO.

Robert M. Yerkes, chairman, research information service, National Research Council, Washington, D. C.

The President of the United States, on the recommendation of the president of the National Academy of Sciences, acting as chairman of the division of federal relations of the National Research Council, has designated the following representatives of the various departments to act as members of this division:

DEPARTMENT OF STATE.

Wilbur J. Carr, Director, Consular Service.

DEPARTMENT OF THE TREASURY.

J. W. Schereschewsky, Assistant Surgeon General, Public Health Service.

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DEPARTMENT OF WAR.

Lieut. Col. Edward T. Donnelly, General Staff, United States Army.
Lieut. Col. W. B. Graham, Military Intelligence Division, United States Army.
Col. Clarence H. McNeil, Coast Artillery, United States Army.
Col. Joseph S. Siler, Medical Corps, United States Army.
Lieut. Col. Clarence O. Sherrill, Engineer Corps, United States Army.
Col. Colden L'H. Ruggles, Ordnance Department, United States Army.
Maj. Gen. George O. Squier, Chief Signal Officer, United States Army.
Maj. Henry W. Harms, Air Service, United States Army.
Brig. Gen. A. A. Fries, Chief, Chemical Warfare Service, United States Army.

DEPARTMENT OF JUSTICE.

William D. Riter, Assistant Attorney General.

POST OFFICE DEPARTMENT.

Joseph Stewart, special assistant to the Attorney General.

DEPARTMENT OF THE NAVY.

Director, Intelligence Division, Office of Naval Operations, United States Navy.
Superintendent, Naval Observatory, Bureau of Navigation, United States Navy.
Rear Admiral Luther E. Gregory, Chief, Bureau of Yards and Docks, United States Navy.
———, Bureau of Ordnance, United States Navy.
Rear Admiral D. W. Taylor, Chief Constructor of the Navy, and Chief, Bureau of Construction and Repair, United States Navy.
Rear Admiral R. S. Griffin, Chief, Bureau of Engineering, United States Navy.
Rear Admiral Edward R. Stitt, Surgeon General, and Chief, Bureau of Medicine and Surgery, United States Navy.

DEPARTMENT OF THE INTERIOR.

William A. Kinnan, First Assistant Commissioner of Patents, Patent Office.
George F. Zook, specialist in higher education, Bureau of Education.
George Otis Smith, Director, Geological Survey.
A. P. Davis, Director, Reclamation Service.
H. Foster Bain, Director, Bureau of Mines.

DEPARTMENT OF AGRICULTURE.

C. F. Marvin, Chief, Weather Bureau.
J. R. Mohler, Chief, Bureau of Animal Industry.
Karl F. Kellerman, Physiologist and Associate Chief, Bureau of Plant Industry.
E. H. Clapp, Assistant Forester, Forest Service.
Frederick B. Power, Pharmaceutical Research Chemist, Bureau of Chemistry.
Milton Whitney, Chief, Bureau of Soils.
L. O. Howard, Entomologist and Chief, Bureau of Entomology.
E. W. Nelson, Biologist and Chief, Bureau of Biological Survey.
T. H. MacDonald, Chief, Bureau of Public Roads.

DEPARTMENT OF COMMERCE.

Joseph A. Hill, chief statistician, Bureau of the Census.
S. W. Stratton, Director, Bureau of Standards.
Hugh M. Smith, Commissioner, Bureau of Fisheries.
William Bowie, Chief, Division of Geodesy, Coast and Geodetic Survey.

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DEPARTMENT OF LABOR.

Ethelbert Stewart, Commissioner, Bureau of Labor Statistics.

SMITHSONIAN INSTITUTION.

Charles D. Walcott, Secretary, Smithsonian Institution; president, National Academy of Sciences, Washington, D. C.

COMMITTEES.

Committee on relations between scientific agencies in State and Federal Governments (joint committee with division of States relations): Chairman of the joint committee and of the section of the division of Federal relations, E. W. Allen, Chief Office of Experiment Stations, United States Department of Agriculture, Washington, D. C.

Committee on Scope of Government Service: Chairman, H. Foster Bain.

Division of Foreign Relations.

Chairman, R. A. Millikan.
Vice chairman, Wilbur J. Carr.
Vice chairman, Vernon Kellogg.
Secretary, Albert L. Barrows.

EXECUTIVE COMMITTEE.

Chairman, R. A. Millikan; vice chairmen, Wilbur J. Carr and Vernon Kellogg; William Bowie, George E. Hale, John C. Merriam, Augustus Trowbridge.

MEMBERS OF THE DIVISION.

EX OFFICIO.

Charles D. Walcott, president, National Academy of Sciences; secretary, Smithsonian Institution, Washington, D. C.

R. A. Millikan, foreign secretary, National Academy of Sciences; director, Norman Bridge Laboratory of Physics, California Institute of Technology, Pasadena, Calif.

Chairman of the executive board of the National Research Council and chairmen of all divisions.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Burton E. Livingston, professor of plant physiology and director laboratory of plant physiology, Johns Hopkins University; permanent secretary, American Association for the Advancement of Science, Washington, D. C.

AMERICAN ACADEMY OF ARTS AND SCIENCES.

A. A. Noyes, director of chemical research, California Institute of Technology, Pasadena, Calif.

AMERICAN PHILOSOPHICAL SOCIETY.

Robert W. Wood, professor of experimental physics, Johns Hopkins University, Baltimore, Md.

DEPARTMENT OF STATE.

Wilbur J. Carr, director, Consular Service, United States Department of State, Washington, D. C.

MILITARY INTELLIGENCE DIVISION, UNITED STATES ARMY.

Lieut. Col. W. B. Graham, Military Intelligence Division, United States Army, Washington, D. C.

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INTELLIGENCE DIVISION, OFFICE OF NAVAL OPERATIONS, UNITED STATES NAVY.

Capt. Luke McNamee, chief, intelligence division, office of Naval Operations, United States Navy, Washington, D. C.

INTERNATIONAL ASTRONOMICAL UNION.

W. W. Campbell, vice president, International Astronomical Union; chairman, executive committee of American section; director, Lick Observatory, University of California, Mount Hamilton, Calif.

INTERNATIONAL GEODETIC AND GEOPHYSICAL UNION.

William Bowie, president, section on geodesy, International Geodetic and Geophysical Union; chairman, American Geophysical Union; chairman, section on Geodesy; chief, Division of Geodesy, United States Coast and Geodetic Survey, Washington, D. C.

C. F. Marvin, secretary, section on meteorology, International Geodetic and Geophysical Union; chairman, section on meteorology, American Geophysical Union; Chief, United States Weather Bureau, Washington, D. C.

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Committee for the investigation of sulphur and phosphorus in steel: J. H. Hall, metallurgical engineer, Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

Joint committee of bureau of mines and bureau of standards on rock-drill steels: Bradley Stoughton.

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J. M. Francis, chief chemist, Parke Davis & Co., Detroit, Mich.

E. C. Franklin, professor of organic chemistry and dean of graduate study, Stanford University, Stanford University, Calif.

W. F. Hillebrand, chief chemist, United States Bureau of Standards, Washington, D. C.

John Johnston, Sterling professor of chemistry, Yale University, New Haven, Conn.

Julius Stieglitz, professor of chemistry and chairman Department of Chemistry, University of Chicago, Chicago, Ill.

J. E. Teeple, consulting chemist and chemical engineer, 50 East Forty-first Street, New York City.

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AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.

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R. B. Moore, chief chemist and chief, Division of Mineral Technology, United States Bureau of Mines, Washington, D. C.

A. A. Noyes, director of chemical research, California Institute of Technology, Pasadena, Calif.

E. W. Washburn, professor of ceramic chemistry and head of the department of ceramic engineering, University of Illinois, Urbana, Ill.

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NATIONAL GEOGRAPHIC SOCIETY.

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C. E. McClung, professor of zoology and director, zoological laboratory, University of Pennsylvania, Philadelphia, Pa.

C. F. Marbut, geologist in charge of soil survey, United States Bureau of Soils, Washington, D. C.

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Henry F. Moore, deputy commissioner, United States Bureau of Fisheries, Washington, D. C.

J. R. Murlin, professor of physiology and director, department of vital economics, University of Rochester, Rochester, N. Y.

Walter T. Swingle, physiologist in charge crop physiology and breeding investigations, United States Bureau of Plant Industry, Washington, D. C.

A. F. Woods, president, University of Maryland, College Park, Md.

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Advisory committee of National Canners' Laboratory: Chairman, Wilder D. Bancroft, professor of physical chemistry, Cornell University, Ithaca, N. Y.

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Committee on educational relations: Chairman, C. E. McClung.

Committee on the Farlow Index: George T. Moore, director, Missouri Botanical Garden, St. Louis, Mo.

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Subcommittee on forest products: Chairman, O. M. Butler, forester, American Forestry Association, Washington, D. C.

Subcommittee on forest management: Chairman, H. H. Chapman, Harriman professor of forest management, Yale University, New Haven, Conn.

Subcommittee on forestry economics: Chairman, S. T. Dana, forest commissioner, Augusta, Me.

Subcommittee on silviculture: Chairman, T. S. Woolsey, jr., secretary-treasurer Connecticut Forestry Association, 242 Prospect Street, New Haven, Conn.

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Committee on standardization of biological stains: Chairman, H. J. Conn, associate bacteriologist, New York Agricultural Experiment Station, Geneva, N. Y.

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Botanical Society of America: Chairman, Charles E. Allen, professor of botany, University of Wisconsin, Madison, Wis.

Ecological Society of America: Chairman, Ellsworth Huntington.

American Association of Economic Entomologists: Chairman, Wilmon Newell, plant commissioner, Florida State plant board; dean, College of Agriculture and director, Agricultural Experiment Station, University of Florida, Gainesville, Fla.

American Society for Horticultural Science: Chairman, U. P. Hedrick.

American Society of Naturalists: Chairman, Bradley M. Davis, professor of botany, University of Michigan, Ann Arbor, Mich.

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A. L. Kroeber, curator of anthropology, Museum of Anthropology; professor of anthropology, University of California, Berkeley, Calif.

Berthold Laufer, curator of anthropology, Field Museum of Natural History, Chicago, Ill.

Clark Wissler, curator of anthropology, American Museum of Natural History, New York City.

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H. C. Warren, Stuart professor of psychology, Princeton University, Princeton, N. J.

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E. L. Thorndike, professor of educational psychology, Teachers' College, Columbia University, New York City.

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C. S. Yoakum, associate professor of applied psychology and director, bureau of personnel research, Carnegie Institute of Technology, Pittsburgh, Pa.

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State subcommittee for Illinois: Chairman, Berthold Laufer.

State subcommittee for Iowa: Chairman, B. F. Shambaugh, professor of political science, University of Iowa, Iowa City, Iowa.

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Committee on prediction of success of students entering higher institutions: Chairman, W. V. Bingham, professor of applied psychology, Carnegie Institute of Technology, Pittsburgh, Pa.

Advisory committee on problems of military psychology: Chairman, Walter Dill Scott, president, Northwestern University, Evanston, Ill.

Committee on race characters: Chairman, Clark Wissler.

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Committee on superior attainment of college students: Chairman, C. E. Seashore.

Committee on vestibular research: Chairman, C. E. Seashore.

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FELLOWSHIPS.

Research Fellowship Board.

A sum, amounting to $500,000 for the period May 1, 1919, to June 30, 1925, has been pledged to be appropriated by the Rockefeller Foundation to the National Research Council for the maintenance of national research fellowships in physics and chemistry,

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under the direction of a research fellowship board appointed by the council of the National Academy of Sciences and the executive board of the National Research Council acting jointly.

The members appointed on this board serve for a period of five years. With them the chairman of the divisions of physical sciences and of chemistry and chemical technology, appointed annually, serve in an ex officio capacity.

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George E. Hale, director Mount Wilson Observatory, Carnegie Institution of Washington, Pasadena, Calif.

John Johnston, Sterling professor of chemistry, Yale University, New Haven, Conn.

Elmer P. Kohler, professor of chemistry, Harvard University, Cambridge, Mass.

R. A. Millikan, director, Norman Bridge laboratory of physics, California Institute of Technology, Pasadena, Calif.

Augustus Trowbridge, professor of physics, Princeton University, Princeton, N. J.

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F. G. Cottrell, chairman, division of chemistry and chemical technology, National Research Council, Washington, D. C.

H. G. Gale, chairman, division of physical sciences, National Research Council; professor of physics, University of Chicago; executive secretary, research fellowship board for 1921–22, Washington, D. C.

Fellowships for 1921–22 have been awarded to the following persons, who have demonstrated a high order of ability in research, for the purpose of enabling them to conduct investigations at educational institutions which make adequate provision for research in physics and chemistry.

IN CHEMISTRY.

James A. Beattie.
Arthur F. Benton.
Francis W. Bergstrom.
F. Russell Bichowsky.
Frederick L. Browne.
George L. Clark.
Edwin J. Cohn.
Roscoe G. Dickinson.
Martin C. E. Hanke.
Rolla Neil Harger.
Selig Hecht.
David C. Jones.
Morris Kharasch.
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Robert S. Mulliken.
Axel R. Olson.
C. S. Palmer.
Henry C. Parker.
Robert N. Pease.
Leonard F. Yntema.

IN PHYSICS.

Ernest F. Barker.
Gregory Breit.
John S. Foster.
Allen Garrison.
Paul S. Helmick.
E. H. Kurth.
Leonard B. Loeb.
John P. Minton.
Jared K. Morse.
George P. Paine.
Henry DeW. Smyth.
Louis T. E. Thompson.
Joseph Valasek.

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APPENDIX B.

ARTICLES OF ORGANIZATION AS AMENDED UP TO JUNE 30, 1922.

PREAMBLE.

The National Academy of Sciences, under the authority conferred upon it by its charter enacted by Congress, and approved by President Lincoln on March 3, 1863, and pursuant to the request expressed in an Executive order made by President Wilson on May 11, 1918, adopts the following articles of organization for the National Research Council, to replace the temporary organization under which it has operated heretofore:

ARTICLE I—PURPOSE.

It shall be the purpose of the National Research Council to promote research in the mathematical, physical, and biological sciences, and in the application of these sciences to engineering, agriculture, medicine, and other useful arts, with the object of increasing knowledge, of strengthening the national defense, and of contributing in other ways to the public welfare, as expressed in the Executive order of May 11, 1918.

ARTICLE II—MEMBERSHIP.

SECTION 1. The membership of the National Research Council shall be chosen with the view of rendering the council an effective federation of the principal research agencies in the United States concerned with the fields of science and technology named in Article I.

SEC. 2. The council shall consist of representatives of national scientific and technical societies; representatives of the Government, as provided in the Executive order; and representatives of other research organizations and other persons whose aid may advance the objects of the council.

ARTICLE III—DIVISIONS.

SECTION 1. The council shall be organized in divisions of two classes: Divisions dealing with the more general relations and activities of the council and divisions dealing with special branches of science and technology.

SEC. 2. The initial constitution of the divisions of the council shall be as follows:

Divisions of general relations: Division of Federal relations, division of foreign relations, division of States relations, division of educational relations, division of research extension, and research information service.

Divisions of science and technology: Division of physical sciences, division of engineering, division of chemistry and chemical technology, division of geology and geography, division of medical sciences, division of biology and agriculture, and division of anthropology and psychology.

SEC. 3. The number of divisions and the grouping of subjects in Article III, section 2, may be modified by the executive board of the National Research Council.

SEC. 4. The divisions of general relations shall be organized by the executive board of the National Research Council. (Art. IV, sec. 2.)

SEC. 5. To secure the effective federation of the principal research agencies in the United States, provided for in Article II, a majority of the members of each of

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the divisions of science and technology shall consist of representatives of scientific and technical societies, who shall be chosen as provided for in Article V, section 2. The other members of the division shall be nominated by the executive committee of the division, approved by the executive board of the National Research Council, and appointed in accordance with Article V, section 4.

SEC. 6. The divisions of the council, with the approval of the executive board, may establish sections and committees, any of which may include members chosen outside the membership of the council.

ARTICLE IV—ADMINISTRATION.

SECTION 1. The affairs of each division shall be administered by a chairman, one or more vice chairmen, and an executive committee, of which the chairman and vice chairman shall be ex officio members. The officers and the executive committee of each of the divisions of general relations shall be appointed by the executive board for such periods as may be determined by the board, except that the foreign secretary of the National Academy of Sciences shall be ex officio chairman of the division of foreign relations. The officers and executive committee of each of the divisions of science and technology shall be elected by the division at its annual meeting and confirmed by the executive board.

SEC. 2. The affairs of the National Research Council shall be administered by an executive board, of which the officers of the National Research Council, the president and home secretary of the National Academy of Sciences, the president of the American Association for the Advancement of Science, the chairmen and vice chairmen of the divisions of science and technology, and the chairmen of the divisions of general relations shall be members ex officio. In the absence of the chairman of a division the vice chairman or other executive officer shall represent him. The council of the National Academy of Sciences and the executive board of the National Research Council, acting jointly, may nominate additional members, not to exceed 12 in number, who, if not already members of the National Research Council, shall be appointed thereto by the president of the National Academy of Sciences for terms of three years. Upon their retirement chairmen of the National Research Council shall continue as members of the executive board for two years beyond the period of their appointment. Subject to the approval of the executive board, the business of the council may be transacted by an interim committee constituted as defined in the by-laws.

SEC. 3. The officers of the National Research Council shall consist of a chairman, a chairman of the executive board, one or more vice chairmen, a permanent secretary, and a treasurer, who shall also serve as members and officers of the executive board of the council.

SEC. 4. The officers of the National Research Council, excepting the permanent secretary and the treasurer, shall be elected annually by the executive board. The permanent secretary of the council shall be elected by the executive board for a period of one year or more. The treasurer of the National Academy of Sciences shall be ex officio treasurer of the National Research Council.

SEC. 5. The duties of the officers of the council and of the divisions shall be fixed by the executive board.

ARTICLE V—NOMINATIONS AND APPOINTMENTS.

SECTION 1. The Government bureaus, civil and military, to be represented in the division of Federal relations and the scientific and technical societies, to be represented in the divisions of science and technology of the National Research Council, shall be determined by joint action of the council of the National Academy of Sciences and the executive board of the National Research Council.

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SEC. 2. Representatives of scientific and technical societies shall be nominated by the societies, at the request of the executive board, and appointed by the president of the National Academy of Sciences to membership in the council and assigned to one of its divisions.

SEC. 3. The representatives of the Government shall be nominated by the president of the National Academy of Sciences after conference with the secretaries of the departments concerned, and the names of those nominated shall be presented to the President of the United States for designation by him for service with the National Research Council.

SEC. 4. Other members of the council shall be nominated by the executive committees of the divisions, approved by the executive board, and appointed by the president of the National Academy of Sciences to membership and assigned to one of the divisions.

SEC. 5. Members of the council shall be appointed for terms of three years, except when appointed to fill unexpired terms.

SEC. 6. The Government representatives shall serve for periods of three years, unless they previously retire from the Government office which they represent, in which case their successors shall be appointed for the unexpired term.

ARTICLE VI—MEETINGS.

SECTION 1. Meetings of the council may be held on call of the executive board.

SEC. 2. The executive board and the divisions shall hold annual meetings, at which, in the case of the divisions of science and technology, officers shall be elected; such other meetings may be called as may be required for the transaction of business. The annual meeting of the executive board shall be held in April in the city of Washington, on a date to be determined as the board may direct.

SEC. 3. Joint meetings of the executive board of the National Research Council and the council of the National Academy of Sciences shall be held from time to time, to consider any matters which, in the judgment of the president of the National Academy, require the attention of both bodies.

ARTICLE VII—PUBLICATIONS AND REPORTS.

SECTION 1. An annual report on the work of the National Research Council shall be presented by the chairman to the National Academy of Sciences for submission to Congress in connection with the annual report of the president of the academy.

SEC. 2. Other publications of the National Research Council may include papers, bulletins, reports, and memoirs, which may appear in the proceedings or memoirs of the National Academy of Sciences, in the publications of other societies, in scientific and technical journals, or in a separate series of the Research Council.

ARTICLE VIII—AMENDMENTS.

SECTION 1. Power of amendment of these articles of organization shall reside in the council of the National Academy of Sciences.

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ANNUAL REPORT OF THE TREASURER.

(July 1, 1921, to June 30, 1922.)

To the PRESIDENT OF THE NATIONAL ACADEMY OF SCIENCES:

I have the honor to submit the following report as treasurer of the academy for the year from July 1, 1921, to June 30, 1922, and as treasurer of the National Research Council for the same period. As is customary, this report is divided into two sections, the first covering the accounts of the National Academy of Sciences and the second covering those of the National Research Council.

In June, 1922, the complete list of investments held by the academy was submitted to Spencer Trask & Co., New York, with a request that it be carefully examined and that suggestion be made of any changes deemed advisable. The reply expressed approval of all the securities and the only recommendations made were (1) that one lot of bonds which were approaching maturity be sold and the money reinvested, and (2) that the academy's $16,000 in British 5½s of 1929, selling at about 109, be exchanged for British 5½s of 1937 at about 102. The first suggestion was followed. The second, which was rather tentatively made, has not yet been acted upon, for if sterling exchange, as seems likely, goes higher the 1929 bonds (convertible at $4.30 to the pound sterling) will still further appreciate in value.

As usual, the greater part of the actual work pertaining to the treasurer's office has been performed by Mr. J. H. J. Yule, the bursar, whose industry, faithfulness, and initiative deserve hearty commendation.

NATIONAL ACADEMY OF SCIENCES.

The total income of the academy from gifts, dues, interest on investments, subscriptions, and contributions to proceedings amounted to $129,762.41. The miscellaneous disbursements amounted to $133,660.93, and payments on grants and for medals from trust funds amounted to $7,922.90.

The total book value of the investments held by the academy on June 30, 1922, was $331,931.75, yielding interest at that date at the rate of 5.45 per cent on the sum named. The market value of these investments on June 30, 1922, as nearly as could be determined, was $329,052.95 and the interest rate as computed on that sum was 5.60 per cent.

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The following table is given to show the diversification of the securities held by the academy:

	Amount.	Per cent.
United States Government bonds	$26,200	7.61
Foreign governments bonds	27,500	7.99
Improved real estate bonds	73,500	21.34
Improved real estate mortgage notes	19,000	5.52
Railroad bonds	55,200	16.03
Municipal bonds	10,000	2.90
Public utilities bonds	37,000	10.74
Power bonds	96,000	27.87
Total	344,400	100.00

Special contributions from members of the academy, amounting to $50, were received by Dr. Charles D. Walcott for the purpose of financing in a more satisfactory way the cost of publishing the proceedings of the academy, the sum named being additional to the $3,171 reported by me last year for the same purpose. A contribution of $1,000 was received from the William Ellery Hale fund for the support of the proceedings.

The sum of $46,190.74 has been received during the year from the Carnegie Corporation of New York, and a similar sum has been disbursed for plans and services for a new building for the use of the National Academy of Sciences and the National Research Council.

Three additional installments, amounting to $16,750, making a total now of $21,750, were received on the bequest of Mrs. Mary Anna Palmer Draper for the Billings fund.

The Pennsylvania Co. for Insurance on Lives and Granting Annuities has remitted to the academy in cash, on account of the Joseph Henry fund, the sum of $18,850.98, of which $1,311.41 was income and $17,539.57 was capital. This company has also turned over to the academy on account of this fund high-grade bonds having a face value of $22,200, representing invested capital, making total receipts in cash and bonds from this source $41,050.98. The capital account of this fund now stands at $39,739.57.

Changes in investments may be summarized as follows: Loans on real estate aggregating $2,500 were paid at maturity. Five bonds of a face value of $5,000 were called for redemption. Sixty-six bonds of a total face value of $59,000 were purchased for $53,486.25. Twenty-five bonds of a face value of $22,200 were acquired from the Pennsylvania Co. for insurance on lives and granting annuities.

The consolidated investment fund now totals $232,235.07, an increase of $56,489.57 having been made since the last report, of which $16,750 represents an increase in the Billings fund and $39,739.57 represents the capital of the Joseph Henry fund.

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TRUST FUNDS OF THE ACADEMY.

The trust funds of the academy, the income of which is administered for specific purposes, are enumerated below. The capital of certain funds has been increased beyond the amount of the original gift or bequest by the transfer of accumulated income at the request of the donors or by action of the academy.

Bache fund: Bequest of Alexander Dallas Bache, a member of the academy, 1870. To aid researches in physical and natural sciences.....	$60,000.00
Watson fund: Bequest of James C. Watson, a member of the academy, 1874. For the promotion of astronomical science through the award of the Watson gold medal and grants of money in aid of research.....	25,000.00
Draper fund: Gift of Mrs. Henry Draper, 1883. In memory of her husband, a former member of the academy. To found the Henry Draper gold medal, to be awarded for notable investigations in astronomical physics. The balance of income is applied to aid research in the same science.....	10,000.00
Smith fund: Gift of Mrs. J. Lawrence Smith, 1884. In memory of her husband, a former member of the academy. To found the J. Lawrence Smith gold medal, to be awarded for important investigations of meteoric bodies and to assist, by grants of money, researches concerning such objects.....	10,000.00
Gibbs fund: Established by gift of Wolcott Gibbs, a member of the academy, 1892, and increased by a bequest of the late Morris Loeb, 1914. For the promotion of researches in chemistry.....	5,545.50
Gould fund: Gift of Miss Alice Bache Gould, 1897. In memory of her father, a former member of the academy. For the promotion of researches in astronomy.....	20,000.00
Comstock fund: Gift of Gen. Cyrus B. Comstock, a member of the academy, 1907. To promote researches in electricity, magnetism, or radiant energy through the Comstock prize of money, to be awarded once in five years for notable investigations. The fund is to be increased, ultimately, to $15,000.....	12,406.02
Marsh fund: Bequest of Othniel Charles Marsh, a member of the academy, 1909. To promote original research in the natural sciences. To the original bequest of $10,000 the academy has added interest received from the estate and has authorized the increase of the fund to $20,000 by annual additions from income.....	20,000.00
Murray fund: A gift from the late Sir John Murray, 1911. To found the Alexander Agassiz gold medal, in honor of a former member and president of the academy, to be awarded for original contribution to the science of oceanography.....	6,000.00
Hartley fund: A gift from Mrs. Helen Hartley Jenkins, 1913–14, in memory of her father, Marcellus Hartley, to found the medal of the academy awarded for eminence in the application of science to the public welfare.....	1,200.00
Billings fund: Established by the bequest of Mrs. Mary Anna Palmer Draper (Mrs. Henry Draper) of $25,000, 1915. To support the publication of the proceedings of the academy or for other purposes, to be determined by the academy, six installments.....	21,750.00
Elliot fund: Gift of Margaret Henderson Elliot, to found the Daniel Giraud Elliot gold medal and honorarium for the most meritorious work in zoology or paleontology published in each year.....	8,000.00

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Thompson fund: Gift of Mrs. Mary Clark Thompson, 1919, the income thereof to be applied for a gold medal of appropriate design to be awarded annually by the academy for the most important services to geology and paleontology, the medal to be known as the Mary Clark Thompson gold medal..... $10,000.00

Joseph Henry fund: The sum of $40,000 was contributed by Fairman Rogers, Joseph Patterson, George W. Childs, and others, as an expression of their respect and esteem for Prof. Joseph Henry. This amount was deposited with the Pennsylvania Co. for the insurance of lives and granting annuities in trust, with authorization to collect the income thereon and to pay over the same to Prof. Joseph Henry during his natural life, and after his death to his wife and daughters, and after the death of the last survivor to "deliver the said fund and the securities in which it shall then be invested to the National Academy of Sciences, to be thenceforward forever held in trust under the name and title of the 'Joseph Henry fund.'" The death of Miss Caroline Henry on November 10, 1920, has removed the last surviving heir of Joseph Henry to the income of the Joseph Henry fund. To assist meritorious investigators, especially in the direction of original research. Amount received by the academy from the Pennsylvania Co..... 39,739.57

In addition to the above-named funds the academy holds the following:

Agassiz fund: Bequest of Alexander Agassiz, a member of the academy, 1910, for the general uses of the academy..... 50,000.00

Total..... 299,641.09

Statement of assets and liabilities, June 30, 1922.

ASSETS.

[Bonds purchased during the year are indicated thus *.]

	Face value.	Book value.	Market value, June 30, 1922.
Mortgage notes, secured by first mortgage on real estate.....	$19,000.00	$19,000.00	$19,000.00
Bonds:			
American Telephone & Telegraph Co., 30-year 5 per cent gold collateral trust, due Dec. 1, 1946; Nos. 4604, 29245, 29246, 41419; 4, at $1,000.....	4,000.00	3,817.50	3,880.00
Asheville Power & Light Co., first mortgage, 30-year gold, 5 per cent, due Apr. 1, 1942, New York; Nos. 272, 490, 492, 508, 509; 5, at $1,000.....	5,000.00	4,892.50	4,550.00
Broadway Realty Co., purchase money first 5 per cent gold, due Sept. 1, 1926; Nos. 50, 796, *906, *922, *923, 963–965, *1005, 1068, 1102, 1139, *1574, 1616–1620, 1629, 1630; 20, at $1,000.....	20,000.00	19,605.00	18,000.00
Bush Terminal Buildings Co., first mortgage 50-year sinking fund, 5 per cent, gold, due Apr. 1, 1960; Nos. 1383–1387 and 2805–2809; 10, at $1,000.....	10,000.00	9,375.00	9,080.00
Chesapeake & Ohio, general mortgage, 4.5 per cent, gold, due New York, Mar. 1, 1992; Nos. 15350–15354; 5, at $1,000.....	5,000.00	4,600.00	4,350.00
City of Tacoma, Green River special water fund No. 2, 5 per cent, due Oct. 1, 1939; Nos. 1508–1511; 4, at $1,000.....	4,000.00	4,140.00	3,920.00
*City of Toronto, Canada, Harbour Commissioners, 4½ per cent gold, due Sept. 1, 1953; Nos. A13744–5, A14040, A14099, A15464, A15466; 6, at $1,000.....	6,000.00	5,400.00	5,250.00

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Statement of assets and liabilities, June 30, 1922—Continued.

ASSETS—Continued.

	Face value.	Book value.	Market value, June 30, 1922.
Bonds—Continued.			
Cleveland Electric Illuminating Co., first mortgage, 5 per cent, due New York, Apr. 1, 1939; Nos. M6060, M6096, M6097, *M9780, *M14911, *M14912, M15094–M15098; 11, at $1,000; Nos. D261–D264; 4, at $500	$13,009.00	$12,297.50	$12,675.00
*Commonwealth Edison Co., first mortgage, gold, 6 per cent, due June 1, 1943; Nos. 58097–58100; 4, at $1,000	4,000.00	3,660.00	4,200.00
Commonwealth Electric Co., first 5 per cent, due June 1, 1943; Nos. 2045–2047, 4011; 4, at $1,000	4,000.00	3,600.00	3,880.00
*Consolidated Gas, Electric Light & Power Co. of Baltimore, first refunding mortgage, 7 per cent, sinking fund, gold, series C, convertible, due Oct. 1, 1931; Nos. M4583–M4592; 10, at $1,000	10,000.00	9,900.00	10,500.00
Cosmos Club, 4.5 per cent, due July 1, 1949; Nos. 286–289, 291–294, 296, 297, 299, 301, 303–305, 350; 16, at $1,000	16,000.00	16,000.00	12,000.00
Detroit Edison Co., first and refunding mortgage, gold, 5 per cent, due Jan. 1, 1940; Nos. 9657–9660; 4, at $1,000; and Nos. D501, D502, D599; 3, at $500	5,500.00	5,005.00	5,115.00
Detroit Edison Co., first mortgage, 30-year gold, 5 per cent, due Jan. 1, 1933; Nos. 557, 2442, 2443, 3024, 3252, 3258, 3639–3641, 3066; 10, at $1,000	10,000.00	10,072.50	9,800.00
*Detroit Edison Co., first and refunding mortgage, 6 per cent, gold, due June 1, 1940; Nos. B14296, B14296, B14299, B16655; 4, at $1,000; No. BD2048; 1, at $500	4,500.00	3,960.00	4,410.00
Dominion Coal Co. (Ltd.), first mortgage, sinking fund, gold, 5 per cent, due New York, Mar. 1, 1940; Nos. A1088, A1089; 2, at $1,000	2,000.00	1,812.50	1,700.00
*Dutch East Indies, 40-year, external sinking fund, gold, 6 per cent, due Mar. 1, 1962; trust receipts Nos. 3058, 41407; 2, at $1,000; No. D2490; 1, at $500	2,500.00	2,386.25	2,362.50
Galveston, Harrisburg & San Antonio, Mexican and Pacific Ex., 6 per cent, second guaranteed; reduced to 5 per cent, due Jan. 1, 1931; Nos. 1044, 1048, 1248, 2112–2116; 8, at $1,000	8,000.00	8,030.00	7,540.00
Georgia Railway & Electric Co., first consolidated mortgage, 5 per cent, sinking fund, gold, due Jan. 1, 1932; Nos. 191, 1061, 1600; 3, at $1,000	3,000.00	2,995.00	2,745.00
Grand Rapids Gas Light Co., 5 per cent, first mortgage, gold, due New York, Aug. 1, 1939; Nos. A522, A523, A595, A596; 4, at $1,000	4,000.00	4,020.00	3,720.00
*Grand Trunk Western Railway Co., first mortgage, 50-year gold, 4 per cent, due July 1 1950; Nos. 4304, 5005, 5006; 3, at $1,000; Nos. 15, 265, 774, 781, 839, 994, 1019, 1055, 1059, 1104, 1139, 1378, 2738, 2884, 2942; 15, at $500	10,500.00	7,690.00	7,875.00
Great Northern Ry. Co., *7 per cent, 15-year general mortgage, series A, due July 1, 1936; temporary certificates; Nos. TM67750–TM67755; 6, at $1,000; TC4849, TC4850; 2, at $100; TD3817; 1, at $500	6,700.00	6,465.50	7,311.38
Hydraulic Power Co. of Niagara Falls, 5 per cent, refunding and improvement mortgage, due Oct. 1, 1951; Nos. *M1990–*M1994; 5 at $1,000; Nos. D244, D457, D458; 3, at $500	6,500.00	5,670.00	6,240.00
*Lehigh Valley Railroad Co., 6 per cent registered Consolidated Mortgage loan annuity bonds, dated Nov. 13, 1873; Nos. 1739–1758; 20, at $1,000	20,000.00	20,000.00	20,000.00

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Statement of assets and liabilities, June 30, 1922—Continued.

ASSETS—Continued.

	Face value.	Book value.	Market value, June 30, 1922.
Bonds—Continued.			
*Liberty, second, converted, 4¼ per cent; 1927–1942; No. CO-1636598; 1, at $100; No. COO920988; 1, at $50	$150.00	$150.00	$142.47
Liberty, third loan, 4¼ per cent, gold of 1928; Nos. 8339 at $10 000; Nos. 2043499–2043833; 25 at $100; and Nos. 4070782–4070787; 6 at $50	12,300.00	12,300.00	12,225.00
Liberty fourth loan 4¼ per cent gold of 1933–1938; Nos. DO4770174 EO4770175; 2 at $100; No. *GOO497567; 1 at $1 000; No. *DO1819904; 1 at $50	1,250.00	1,250.00	1,200.00
Michigan Northern Power Co. first mortgage guaranteed 5 per cent, due 1941; Nos. 5054, 5057, 5316, 5516, 5567–5571, 5515; 10 at $1,000; and Nos. 4267, 4268; 2 at $500	11,000.00	9,540.00	10,120.00
Milwaukee Electric Railway & Light Co. 5 per cent general and refunding mortgage, gold, series A, due New York Dec. 1, 1951; Nos. 2088, 2772, 3830, 3840, 3930, 3931, 5922–5294; 9 at $1,000	9,000.00	8,237.50	7,650.00
*Milwaukee Electric Railway & Light Co. 7½ per cent 20-year refunding and first mortgage, gold, series A, due June 1, 1941; No. D890; 1 at $500	500.00	475.00	505.00
Minneapolis General Electric Co. 5 per cent 30-year gold mortgage, due New York Dec. 1, 1934; Nos. 1621, 1622, 1949, 2004, 2572–2575, 7579, 7580; 10 at $1,000	10,000.00	9,600.00	9,700.00
*Nevada-California Electric Corporation 6 per cent first lien, series A, due Jan. 1, 1946, New York; 1 at $1,000; No. M409	1,000.00	960.00	995.00
*Nevada-California Electric Corporation 6 per cent first lien, gold, series B, due New York, Oct. 1, 1959; 1, at $500; No. D166	500.00	475.00	497.50
*New York Telephone Co., 6 per cent, 20-year, refunding mortgage, gold, series A, due Oct. 1, 1941; No. 9018; 1, at $500	500.00	485.00	530.00
Niagara Falls Power Co., first mortgage, 5 per cent, gold, coupon, due Jan. 1, 1932; Nos. 5246, 5247, 6583, 8358; 4, at $1,000	4,000.00	4,100.00	3,960.00
Niagara Falls Power Co., first mortgage, 5 per cent, gold, registered, due Jan. 1, 1932; No. R484; 1, at $5,000	5,000.00	5,700.00	5,040.00
Riggs Realty Co., 3–30-year coupon, first, 5 per cent, due Washington, D. C., Oct. 1, 1940; Nos. 136, 140, 144; 3, at $1,000	3,000.00	3,097.50	2,760.00
Shawinigan Water & Power Co., 5 per cent, consolidated mortgage, 30-year, gold, due Jan. 1, 1934; Nos. MO354, MO510, M2894, M2943; 4, at $1,000	4,000.00	3,822.50	3,920.00
Southern Bell Telephone & Telegraph Co., 30-year, first mortgage, 5 per cent, sinking fund, gold, due Jan. 1, 1941; Nos. M9739, M11576–M11579, M13965, M15568–M15570; 9, at $1,000	9,000.00	8,942.50	8,460.00
*State of Queensland, 20-year, 7 per cent, sinking fund, external loan, gold, due Oct. 1, 1941; Nos. 8224–8231; 8, at $1,000	8,000.00	7,940.00	8,650.00
Swiss Government, 8 per cent, due July 1, 1940; No. 3400; 1 at $1,000	1,000.00	1,000.00	1,137.50
Trinity Buildings Corporation, first mortgage, gold, 5½ per cent, due 1939; Nos. M5229–M5243; 15, at $1,000; and Nos. D697–D706; 10, at $500	20,000.00	19,900.00	19,600.00
Two Rector Street Corporation, first mortgage, 15-year, sinking fund, gold loan, 6 per cent, due Apr. 1, 1935; No. M300; 1, at $1,000; No. D152, 1, at $500	1,500.00	1,500.00	1,470.00
Union Electric Light & Power Co., of St. Louis, 5 per cent, first mortgage, 30-year, gold, due New York, Sept. 1, 1932; Nos. 1352, 4169, 8601, 3821; 4, at $1,000	4,000.00	3,762.50	3,720.00

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Statement of assets and liabilities, June 30, 1922—Continued.

ASSETS—Continued.

	Face value.	Book value.	Market value, June 30, 1922.
Bonds—Continued.			
United Kingdom of Great Britain and Ireland, ten year, 5½ per cent, due Aug. 1, 1929; Nos. M138584-M138599; 16, at $1,000	$16,000.00	$15,408.00	$17,240.00
Vicksburg, Shreveport & Pacific R. R. Co., prior-lien mortgage, at 6 per cent, gold, renewed at 5 per cent, due Nov. 1, 1915, extended to Nov. 1, 1940; Nos. 561, 661, 794, 982, 1323; 5 at $1,000	5,000.00	5,050.00	4,400.00
*John Wanamaker, 5 per cent, first mortgage, gold, due Apr. 1, 1923; registered; No. 395: 1, at $1,000	1,000.00	1,000.00	1,000.00
Total	$13,400.00	300,981.75	298,052.95
Other United States securities held	12,000.00	12,000.00	12,000.00
Grand total	344,400.00	331,981.75	329,052.95

SUMMARY.

Book value of securities as above	$331,931.75
Accrued interest on securities purchased	75.50
	332,007.25
Bank balance, June 30, 1922	9,459.08
Total	341,466.33

LIABILITIES.

	Income.	Capital.		Income.	Capital.
General fund:			Gibbs fund:		
Invested	$420.00		Invested	$500.00	$5,545.50
Uninvested	1,558.05		Uninvested	349.16	
Agassiz fund:			Gould fund:		
Invested		$50,000.00	Invested	7,170.00	19,752.50
Uninvested			Uninvested	2,110.03	247.50
Bache fund:			Hale lectureship:		
Invested		60,000.00	Invested	200.00	
Uninvested	948.58		Uninvested	58.38	
Billings fund: Invested	50.00	21,750.00	Hartley fund:		
Building site:			Invested		1,200.00
Invested	2,757.50		Uninvested	198.36	
Uninvested	355.62		Henry fund:		
Comstock fund:			Invested		$39,739.57
Invested	500.00	12,168.75	Uninvested	$2,270.67	
Uninvested	2,231.86	237.27	Marsh fund:		
Consolidated fund: Uninvested	1,746.16		Invested	150.00	26,000.00
Draper fund:			Uninvested	329.27	
Invested	917.50	10,000.00	Murray fund:		
Uninvested	779.66		Invested	400.00	6,000.00
Elliot fund:			Uninvested	1,109.09	
Invested	300.00	8,000.00	Proceedings:		
Uninvested	678.56		Academy account, uninvested	1,678.29	

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Statement of assets and liabilities, June 30, 1922—Continued.

LIABILITIES—Continued.

	Income.	Capital.		Income.	Capital.
Proceedings—Continued.			Watson fund:		
Joint account, uninvested	$2,014.24		Invested	$1,780.09	$24,063.75
Emergency fund proceedings:			Uninvested	1,333.08	336.25
Invested	1,870.00		Total	41,825.24	200,641.00
Uninvested	196.11		Consolidated investment fund:		
Smith fund:			Invested		222,219.25
Invested	2,542.50	$10,000.00	Uninvested	1,746.16	15.82
Uninvested	1,645.66			1,746.16	222,235.07
Thompson fund:					
Invested		10,000.00			
Uninvested	176.06				

Condensed statement of receipts and expenditures, July 1, 1921, to June 30, 1922

RECEIPTS.

Balance July 1, 1921, as per last report		$21,280.50
Cash receipts:		
Academy proceedings—		
Annual dues	$1,017.50	
Subscriptions	188.45	
Reprints and separates	157.09	
Special contributions secured by Dr. Chas. D. Walcott	50.00	
Contribution by William Ellery Hale fund	1,000.00	
		$2,413.04
Joint proceedings—		
Subscriptions	705.40	
Reprints and separates	407.47	
National Research Council	2,500.00	
		3,612.87
General fund, annual dues		855.00
Building construction fund, contribution by Carnegie Corporation of New York		46,190.74
Joseph Henry fund, from Pennsylvania Co. for Insurance on Lives and Granting Annuities		18,850.98
Billings fund, from the estate of Mrs. Mary Anna Palmer Draper		16,750.00
Total income from investments		17,519.47
Mortgage notes paid		2,500.00
Bonds called and sold		10,798.50
Profit on sale of bonds		220.44
Sale of United States Treasury certificates		10,051.37
		129,762.41
Book transfers, distribution of consolidated		10,448.23
Total		161,491.14

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EXPENDITURES.

Book transfers, distribution of consolidated			$10,448.23
Cash expenditures:			
Building construction fund, for plans and services		$46,190.74	
Building site fund, blue prints, plats, and photos		226.50	
General fund—			
Salary, assistant secretary	$900.00		
Home secretary's office	1,076.54		
Treasurer's office	211.60		
Meetings—			
Annual	$800.46		
Autumn	243.81		
	1,044.27		
Election of members	124.51		
		3,356.92	
Academy proceedings, printing and distributing	54.08		
		54.08	
Joint proceedings—			
Salary, managing editor	750.00		
Printing and distributing	5,055.35		
Expenses—			
Boston office	174.25		
Washington office	96.45		
		6,076.05	
Investment of capital		53,486.25	
Accrued interest on bonds purchased		583.52	
Purchase of United States Treasury certificates and interest		23,686.87	
			133,660.93
Payments from trust and other funds:			
Bache fund—			
Frank P. Underhill and Lafayette B. Mendel grant	$800.00		
Preston Edwards grant	750.00		
T. H. Goodspeed grant	80.00		
Herbert M. Evans grant	500.00		
H. Nort grant	200.00		
Herbert S. Jennings grant	300.00		
H. W. Norris grant	300.00		
Carl Hartman grant	500.00		
		3,430.00	
Draper fund, W. W. Campbell grant		450.00	
Elliot fund, Othenio Abel, grant and medal		428.00	
Henry fund, Ales Hrdlicka grant		500.00	
Marsh fund—			
C. W. Gilmore grant	400.00		
M. Ferdinand Canu grant	400.00		
Carl O. Dunbar grant	65.42		
W. J. Sinclair grant	300.00		
Winifred Goldring grant	75.00		
Rudolph Ruedemann grant	200.00		
		1,440.42	

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Payments from trust and other funds—Continued.		
Smith fund—		
Stuart R. Brinkley grant	$300.00	
Charges on medal	5.58	
		$305.58
Thompson fund, designing medal, etc.		268.90
Watson fund—		
John A. Miller grant	500.00	
William Bowie grant	300.00	
H. C. Wilson grant	300.00	
		1,100.00
Total payments from trust funds		$7,922.90
		152,032.06
Balance June 30, 1922		9,459.08
Total		161,491.14

Accounts with individual funds, July 1, 1921, to June 30, 1922.

	General fund.		Agassiz fund.	
	Income.	Capital.	Income.	Capital.
Balance July 1, 1921:				
Cash	$973.91			
Invested				$20,000.00
Receipts:				
Interest on investments	3,516.06			
Annual taxes	855.00			
Total	5,344.97			20,000.00
Disbursements, general expenses	3,356.92			
Balance June 30, 1922:				
Cash	1,558.05			
Invested	430.00			20,000.00
Total	5,344.97			20,000.00

	Bache fund.		Billings fund.	
	Income.	Capital.	Income.	Capital.
Balance July 1, 1921:				
Cash	$1,234.39			
Invested		$60,000.00	$50.00	$5,000.00
Receipts:				
Interest on investments	3,144.19		693.57	
Estate of Mary Anna Palmer Draper				16,750.00
Total	4,378.58	60,000.00	743.57	21,750.00
Disbursements:				
Grants	3,430.00			
Transfer to academy proceedings			693.57	
Balance June 30, 1922:				
Cash	948.58			
Invested		60,000.00	50.00	21,750.00
Total	4,378.58	60,000.00	743.57	21,750.00

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Accounts with individual funds, July 1, 1921, to June 30, 1922—Continued.

	Building construction.		Building site.	
	Income.	Capital.	Income.	Capital.
Balance July 1, 1921:				
Cash			$479.95	
Invested			2,240.00	
Receipts:				
Interest on investments			625.00	
Carnegie Corporation of New York	$46,190.74			
Total	46,190.74		3,344.95	
Disbursements:				
Plans and services	46,190.74			
Blue prints, plats, photos			226.50	
Accrued interest from bonds purchased			5.33	
Balance June 30, 1922:				
Cash			355.62	
Invested			2,757.50	
Total	46,190.74		3,344.95	

	Comstock fund.		Consolidated fund.	
	Income.	Capital.	Income.	Capital.
Balance July 1, 1921:				
Cash	$1,601.68	$141.02	$1,310.25	$1,517.75
Invested	500.00	12,265.00		174,227.75
Receipts:				
Interest on investments	628.18		11,149.47	
Profit on sale of bonds	2.00		186.69	
Capital transfer (Henry)				39,739.57
Capital transfer (Billings)				16,750.00
Total	2,731.86	12,406.02	12,646.41	232,235.07
Disbursements:				
Distribution of consolidated			10,443.23	
Accrued interest on bonds purchased			452.02	
Balance June 30, 1922:				
Cash	2,231.86	237.27	1,746.16	15.82
Invested	500.00	12,168.75		232,219.25
Total	2,731.86	12,406.02	12,646.41	232,235.07

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Accounts with individual funds, July 1, 1921, to June 30, 1922—Continued.

	Draper fund.		Elliot fund.	
	Income.	Capital.	Income.	Capital.
Balance July 1, 1921:				
Cash	$665.66		$674.96	
Invested	917.50	$10,000.00	300.00	$8,000.00
Receipts, interest on investments	574.00		431.60	
Total	2,147.16	10,000.00	1,406.56	8,000.00
Disbursements, grants and medals	450.00		428.00	
Balance June 30, 1922:				
Cash	779.66		678.56	
Invested	917.50	10,000.00	300.00	8,000.00
Total	2,147.16	10,000.00	1,406.56	8,000.00

	Gibbs fund.		Gould fund.	
	Income.	Capital.	Income.	Capital.
Balance July 1, 1921:				
Cash	$336.89		$997.72	$2,007.50
Invested	500.00	$5,545.50	7,010.00	17,992.50
Receipts:				
Interest on investments	312.27		1,436.34	
Profit on sale of bonds			27.75	
Total	849.16	5,545.50	9,371.81	20,000.00
Disbursements: Accrued interest on bonds purchased			91.78	
Balance June 30, 1922:				
Cash	349.16		2,110.03	247.50
Invested	500.00	5,545.50	7,170.00	19,752.50
Total	849.16	5,545.50	9,371.81	20,000.00

	Hale lectureship.		Hartley fund.	
	Income.	Capital.	Income.	Capital.
Balance July 1, 1921:				
Cash	$44.83		$130.68	
Invested	200.00			$1,200.00
Receipts: Interest on investments	8.50		62.68	
Total	253.33		193.36	1,200.00
Balance June 30, 1922:				
Cash	53.33		193.36	
Invested	200.00			1,200.00
Total	253.33		193.36	1,200.00

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Accounts with individual funds, July 1, 1921, to June 30, 1922—Continued.

	Henry fund.		Marsh fund.	
	Income.	Capital.	Income.	Capital.
Balance July 1, 1921:				
Cash			$1,215.09	
Invested			150.00	$20,000.00
Receipts:				
Interest on investments	$1,459.26		1,054.60	
From Pennsylvania Company, for insurance on lives and granting annuities	1,311.41	$39,739.57		
Total	2,770.67	39,739.57	2,419.69	20,000.00
Disbursements: Grants	500.00		1,440.42	
Balance June 30, 1922:				
Cash	2,270.67		829.27	
Invested		39,739.57	150.00	20,000.00
Total	2,770.67	39,739.57	2,419.69	20,000.00

	Murray fund.		Smith fund.	
	Income.	Capital.	Income.	Capital.
Balance July 1, 1921:				
Cash	$777.23		$1,288.49	
Invested	400.00	$6,000.00	2,542.50	$10,000.00
Receipts: Interest on investments	331.86		662.75	
Total	1,509.09	6,000.00	4,493.74	10,000.00
Disbursements: Grants and medals			305.58	
Balance June 30, 1922:				
Cash	1,109.09		1,645.66	
Invested	400.00	6,000.00	2,542.50	10,000.00
Total	1,509.09	6,000.00	4,493.74	10,000.00

	Academy proceedings.		Joint proceedings.	
	Income.	Capital.	Income.	Capital.
Balance July 1, 1921, cash	$1,125.76		$1,977.42	
Receipts:				
Subscriptions	188.45		705.40	
Annual dues	1,017.50			
Reprints and separates	157.09		407.47	
Transfer from Billings fund	693.57			
Special contributions secured by Dr. Chas. D. Walcott	50.00			
Contribution by William Ellery Hale fund	1,000.00			
Contribution by National Research Council			2,500.00	
Transferred from academy proceedings to joint proceedings representing contribution by National Academy of Sciences			2,500.00	
Total	4,232.37		8,090.29	

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Accounts with individual funds, July 1, 1921, to June 30, 1922—Continued.

	Academy proceedings.		Joint proceedings.	
	Income.	Capital.	Income.	Capital.
Disbursements:				
Salary of managing editor			$750.00	
Printing and distributing	$54.08		5,055.35	
Expenses, Boston office			174.25	
Expenses, Washington office			96.45	
Transferred from academy proceedings to joint proceedings representing contributions by National Academy of Sciences	2,500.00			
Balance June 30, 1922, cash	1,678.29		2,014.24	
Total	4,232.37		8,090.29	

	Emergency-fund proceedings.		Thompson fund.	
	Income.	Capital.	Income.	Capital.
Balance July 1, 1921:				
Cash	$2,040.00		$20.86	
Invested				$10,000.00
Receipts, interest on investments	50.00		425.00	
Total	2,090.00		445.86	10,000.00
Disbursements:				
Accrued interest on bonds purchased	22.89			
Designing of medal, etc			245.00	
Charges on medal			23.90	
Balance June 30, 1922:				
Cash	196.11		176.96	
Invested	1,870.00			10,000.00
Total	2,090.00		445.86	10,000.00

	Watson fund.	
	Income.	Capital.
Balance July 1, 1921:		
Cash	$1,104.71	$23.75
Invested	1,780.00	24,976.25
Receipts:		
Interest on investments	1,402.37	
Profits on sale of bonds	4.00	
Total	4,291.08	25,000.00
Disbursements:		
Grants	1,100.00	
Accrued interest on bonds purchased	10.80	
Loss on sale of bonds	67.80	
Balance June 30, 1922:		
Cash	1,332.08	336.25
Invested	1,780.00	24,663.75
Total	4,291.08	25,000.00

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NATIONAL RESEARCH COUNCIL.

During the fiscal year ended June 30, 1922, the activities of the National Research Council were supported by funds derived from various sources. The following list gives the main sources of these funds:

(1) For general maintenance expenses of the National Research Council the sum of $185,000 was received from the Carnegie Corporation of New York.

(2) From the Rockefeller Foundation the following amounts were received for the special purposes indicated: For the division of physical sciences, $6,679.17; for national research fellowships, year 1921 (R. F. 2517), $32,941.81, and for the same purpose, year 1922 (R. F. 2608), $42,266.51; for fellowships in medicine (R. F. 2632), $231.85; for the rehabilitation of Concilium Bibliographicum, year 1921, $15,000; and for the same purpose, year 1922, $15,000.

(3) From the General Education Board contributions were received as follows: For special work carried on by the division of educational relations, $2,500, and for fellowships in medicine, $231.84.

(4) From various organizations for the advisory board on highway research, $14,000.

(5) From various organizations, chiefly railroads, for marine piling investigations, $15,797.

(6) From the Chemical Foundation: For special work by the research information service, $7,500, and for standardization of biological stains, $500.

(7) Other contributions included: The sum of $2,000 from Julius Rosenwald toward the support of a fellowship in biology; from the Corning Glass Works toward the support of a fellowship in ceramics, $1,000; from the Southern Pine Association for the use of the committee on forestry, $3,000; from various organizations, for the use of the food and nutrition committee, $1,350; from Glass Containers' Association of America, for an investigation of food products, $568.28; from various individuals, for international language, $950; from Theodore Lyman, special contribution for physical and chemical constants, $1,000; from various sources, for the committee on substitute deoxidizers, $400; for the use of the committee on atmosphere and man, $1,000; for expenses of chemical exhibits, $8,317.40; for motion-picture films, chemical exhibits, $1,500; for conference on sex research, $1,000; for national intelligence tests, $1,602.07; for trustees for the publication of physical and chemical constants, $13,736.73.

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Receipts and disbursements, National Research Council, from July 1, 1921, to June 30, 1922.

RECEIPTS.

July 1, 1921, cash in bank		$5,898.32
Appropriations:		
Rockefeller Foundation—		
Physical sciences (R. F. 2518)	$6,679.17	
National Research fellowships (R. F. 2517)	32,941.81	
National Research fellowships (R. F. 2608)	42,266.51	
Fellowships in medicine (R. F. 2632)	231.85	
Concilium Bibliographicum (1921)	15,000.00	
Concilium Bibliographicum (1922)	15,000.00	
General Education Board—		
Division of educational relations	2,500.00	
Fellowships in medicine	231.84	
Carnegie Corporation of New York	185,000.00	
Rosenwald fellowships	2,000.00	
Research fellowships in ceramics supported by Corning Glass Works	1,000.00	
Chemical Foundation—		
For special work by research information service	7,500.00	
For standardization of biological stains	500.00	
Food and nutrition committee	1,350.00	
Food products investigation fund	568.28	
Committee on forestry	3,030.00	
Receipts from subscriptions, Concilium Bibliographicum	294.02	
Marine piling investigations	15,797.00	
International auxiliary language	950.00	
Advisory board on highway research	14,000.00	
Committee on substitute deoxidizers	400.00	
Committee on the atmosphere and man	1,000.00	
Trustees for the publication of physical and chemical constants	13,736.73	
Sale of United States Treasury certificates	3,510.04	
Interest on United States Treasury certificates	665.04	
Expenses of chemical exhibits	8,317.40	
Motion picture films chemical exhibit	1,500.00	
Conference on sex research	1,000.00	
National intelligence tests	1,602.07	
Special contribution of Theodore Lyman	1,000.00	
Unappropriated fund, special, interest on investments	158.48	
Sale of United States Treasury certificates	105,780.92	
Interest on United States Treasury certificates	4,320.14	
Miscellaneous receipts	28,450.56	
Reimbursements	13,460.22	
		531,742.06
		537,640.38

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DISBURSEMENTS.

Divisions:	
I. Federal relations, general maintenance, 1922	
II. Foreign relations—	
General maintenance, 1922	$257.68
Foreign dues	39.61
III. States relations—	
General maintenance, 1921	290.12
General maintenance, 1922	1,032.77
IV. Educational relations—	
General maintenance, 1922	411.72
General Education Board	2,397.42
V. Research extension—	
General maintenance, 1921	26.50
General maintenance, 1922	1,642.17
Expenses of chemical exhibit, 1922	8,317.40
Motion-picture films chemical exhibit	1,500.00
Special contribution of Theodore Lyman	1,000.00
VI. Research information service—	
General maintenance, 1921	124.17
General maintenance, 1922	2,362.13
Contingent expenses, 1921	395.75
Equipment, 1921	331.57
Equipment, 1922	3,769.74
National Academy, proceedings and subscriptions, 1922	2,500.00
Geological bibliography, 1922	250.00
System of classification, 1922	550.00
Biological bibliography, 1922	272.65
Survey of informational resources, 1922	579.49
Special travel, 1922	47.78
VII. Physical sciences—	
General maintenance, 1922	1,894.04
Revolving fund for publication of mathematical books, 1922	250.00
Rockefeller Foundation (R. F. 2518), travel expenses	10,632.65
Special fund, 1922	100.00
Refunds	1,223.64
Traveling expenses American section International Astronomical Union, 1922	493.16
Traveling expenses American section International Union of Scientific Radio Telegraphy, 1922	700.00
VIII. Engineering—	
General maintenance, 1921	152.82
General maintenance, 1922	1,690.57
Office expenses, 1922	520.41
Projects, 1921	1,748.41
Advisory board on highway research, 1922	13,039.73
Marine piling investigations, 1922	6,067.57
Marine piling investigations restricted, 1922	353.73

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Divisions—Continued.

IX. Chemistry and chemical technology—	
General maintenance, 1921	$10.50
General maintenance, 1922	764.18
International auxiliary language	887.51
Research fellowships (R. F. 2517), 1921	37,947.13
Research fellowships (R. F. 2608) 1922	40,061.01
Research fellowships, in ceramics, supported by Corning Glass Works	1,000.00
Trustees for the publication of physical and chemical constants	2,121.92
Purchase of United States Treasury certificates	16,534.38
Projects	250.00
Traveling expenses, Union of Pure and Applied Chemistry, 1922	800.00
X. Geology and geography—	
General maintenance, 1922	756.52
Projects	750.00
Antevs project, 1922	500.00
Traveling expenses International Geology Congress, 1922	400.00
XI. Medical Sciences—	
General maintenance, 1922	1,054.83
International Association of Medical Museums, 1921	500.00
Study of empyema, 1921–22	392.30
Conference on contagious abortion in animals, 1921–22	250.00
Conference on sex research, 1922	1,000.00
Study of the tuberculosis death certificates in Colorado, 1922	886.00
Fellowships in medicine, 1922	1,023.40
XII. Biology and agriculture—	
General maintenance, 1921	58.47
General maintenance, 1922	3,064.80
Botanical abstracts, 1921	2,245.82
Committee on forestry	4,296.31
Food and nutrition committee	865.12
Food products investigation fund	856.71
Physiological salt requirements committee, 1921	251.63
Committee on fertilizers and committee on plant nutrition, 1922	78.78
Research in tropical America, 1922	156.12
Rosenwald fellowship	2,000.00
Committee on standardization of biological stains	495.76
Committee on the atmosphere and man, 1922	602.70
Biological relation of insects to flowers, 1922	39.67
Conference on federation of American biological societies, 1922	500.00
Rust project, 1922–23	38.80

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Divisions—Continued.		
XIII. Anthropology and psychology—		
General maintenance, 1921	$16.92	
General maintenance, 1922	1,783.90	
American archæological project, 1921	267.20	
Psychological projects, 1921	1,000.00	
National intelligence tests, 1921	200.00	
Funds for vestibular research, 1921	400.00	
Committee on vestibular research, 1922	628.58	
Executive board—		
General maintenance, 1920	48.64	
General maintenance, 1921	25.01	
General maintenance, 1922	2,292.46	
American Geophysical Union—		
General maintenance, 1921	10.75	
General maintenance, 1922	325.38	
Traveling expenses, 1922	1,200.00	
Publicity committee—		
General maintenance, 1921	35.00	
Publications, 1921	2,479.95	
Publications and publicity—		
General maintenance, 1922	4,869.22	
Concilium Bibliographicum	15,000.00	
Concilium Bibliographicum, 1922	14,827.04	
Committee on Concilium Bibliographicum, 1922	250.00	
Receipts from subscriptions Concilium Bibliographicum	294.02	
Committee on conservation, 1921	357.01	
Scientific Instrument Journal, 1922	2,389.90	
American committee to aid European scientists, 1922	131.60	
Auditors' fees, 1921	150.00	
Contingent expenses, 1922	870.42	
Electricity, 1922	765.05	
Expenses and supplies, 1921	425.50	
Expenses and supplies, 1922	4,162.16	
Fuel, 1922	1,205.45	
New equipment, general, 1922	1,348.81	
Rent, 1922	6,875.00	
Rent, 1923	625.00	
Salaries, 1922	140,660.00	
Telephone and telegraph, 1921	117.43	
Telephone and telegraph, 1922	1,238.51	
Unappropriated project fund, 1922	120.00	
Purchase of United States Treasury certificates	111,263.75	
Total		$509,065.43
June 30, 1922, cash in bank:		
American Security & Trust Co., research fellowships	1,645.79	
Riggs National Bank, various accounts	26,929.18	
		28,574.97
		537,640.40

F. L. RANSOME, *Treasurer.*

JULY 28, 1922.

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REPORT OF THE AUDITING COMMITTEE.

WASHINGTON, D. C., *July 31, 1922.*

We have employed the Capital Audit Co. to scrutinize and report on the treasurer's books. We accepted the certificate, dated July 1, 1922, of the American Security & Trust Co. regarding notes owned by the academy and deposited for collection; we have examined the securities owned by the academy and papers contained in the box of the National Academy of Sciences at the vault of the American Security & Trust Co. We find them to correspond to the list checked by the auditing committee on July 17, 1922, except as modified by transactions since July 1, 1922, reported by the Capital Audit Co. We find that the coupons falling due during this period have been cut and accounted for, and those due July 1, 1922, have been deposited and are accounted for by appropriate entries in the pass book. We find that interest on loans has been accounted for. Correspondence between vouchers, pass books, and accounts of the treasurer is certified by the Capital Audit Co. We find the net balance reported by the treasurer as of June 30, 1922, to accord with the statement of the American Security & Trust Co. and with the check book. The above paragraph relates to the accounts of the National Academy of Sciences proper.

The Capital Audit Co. has made a special report on the accounts of the National Research Council, whose funds are deposited in two separate accounts to the credit of the academy. We have examined the long-term securities of the National Research Council deposited in the box at the American Security & Trust Co. and find them correct. We accepted the certificate, dated June 30, 1922, of the Riggs National Bank as to United States Treasury certificates of indebtedness owned by the National Research Council and held by the bank for collection. We find that the net balance reported by the treasurer as of June 30, 1922, agrees with the statements of the American Security & Trust Co. and the Riggs National Bank for these accounts. Correspondence between vouchers, pass books, and accounts of the treasurer for the National Research Council is certified by the Capital Audit Co.

WHITMAN CROSS,
DAVID WHITE,
L. O. HOWARD,
Auditing Committee.

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JOHN CASPER BRANNER.

[From Science, New Series, vol. 55, No. 1422, March 31, 1922, pp. 340-341.]

John Casper Branner, geologist and president emeritus of Stanford University, was born in Newmarket, Tenn., July 4, 1850, and died in Palo Alto, Calif., on March 1, 1922. He entered Cornell University in 1870, soon after its organization, graduating in 1874 as bachelor of science, subsequently receiving the degree of Ph. D. from Indiana University and that of LL. D. from the University of California. In 1883 he married Susan D. Kennedy, of Oneida, N. Y., and left three children: John K., architect, George C., geologist-philosopher, and Elsie, Mrs. Frederick Hall Fowler.

His advanced work at Cornell was under a great teacher of geology, Charles Frederick Hartt, who (during vacations) acted as imperial geologist of Brazil. Thus with Orville A. Derby, Richard Rathbun, Herbert H. Smith, and other student assistants, Branner went to Brazil, where, upon the death of Hartt in 1875, he became director of the imperial geological commission. Afterwards, Brazil having become a Republic, he entered the service of the Sao Cyriaco Mining Co. at Minas Geraes as engineer and interpreter. Later he again went to Brazil and to Argentina as special botanist for Thomas A. Edison in search of wood fitted for certain electrical uses, and still later represented the United States Department of Agriculture in the former country. Returning to America in 1883, he served as topographical geologist of the survey of Pennsylvania, a position resigned to accept that of professor of geology in the University of Indiana, where his college friend, the present writer, had just been appointed president. In 1891 he entered the faculty of the newly founded Stanford University as professor of geology, later becoming vice president of the institution. In 1913, when the title of chancellor was created for me that I might be free for public service, he was elected president of the university, and held that office up to his retirement as emeritus in 1917.

Branner directed three scientific expeditions to Brazil: One under the patronage of Alexander Agassiz in 1899; one in 1907 supported by Richard A. F. Penrose, a former assistant professor at Stanford; and a third in 1911 for the Brazilian Government. This last made a geological and biological study of the coast north and south of the mouth of the Amazon River, the especial purpose being to determine the effect of the great volume of fresh water brought into the ocean by the Amazon upon the marine life of the ocean.

His publications include a volume on the geology of Brazil, with a large number of special papers, and a grammar of the Portuguese language. His other memoirs on geology and physical geography

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are very numerous; his Bibliography of Clays and Arts isan important contribution to that subject.

Branner was a fellow of the Geological Society of America, a member of the Geological Society of London, of the Société Géologique de France, the National Academy of Sciences, the American Philosophical Society. He was also a member and for a time president of the American Seismological Society, and associate editor of the Journal of Geology. In 1906 he was appointed to the California earthquake commission, and in 1915 served the United States Government on the commission to investigate the land slides on the Panama Canal.

In 1911 the Hayden medal was conferred upon him by the Academy of Natural Science of Philadelphia, "in recognition of the value of contributions to geological science, and of the benefits derived from his able and conscientious discharge of the official trusts confided to him."

In 1912 he published "How and Why Stories," a delightful collection of tales told by negroes in Tennessee, bearing on the episodes of creation—"how the snake lost his legs," and the like—quite worthy of place beside the Georgia tales of "Uncle Remus."

In person Branner was robust and vigorous, six feet in height and well proportioned, a man of attractive personality and excellent address. In college he was noted for his dry humor, unfailing readiness, and good nature. As a teacher he was singularly successful in training men to thorough and accurate dealing with problems of geology and mining, gaining the personal love and confidence of his students. Among his disciples are many of high standing in the profession: Herbert Hoover, Robert V. Anderson, Frank M. Anderson, Ralph Arnold, George H. Ashley, Carl H. Beal, Willis S. Blatchley, W. J. Crook, H. W. Durrell, Noah F. Drake, Frank L. Hess, Theodore L. Hoover, J. M. Hyde, D. S. Kimball, E. M. Kindle, Newton B. Knox, Henry Landes, Deane P. Mitchell, James H. Means, John F. Newsom, Frederick W. Nobs, Edward H. Nutter, W. A. Pritchard, A. H. Purdue, Milnor Roberts, Hugh Rose, Claude Siebenthal, E. K. Soper, Herbert S. Stark, Stephen Taber, Frederick P. Vickery, Gerald A. Waring, H. E. Williams, Hayes Young, and many others well known in science or mining. The "Branner Club," of Los Angeles, is composed of his students in geology.

I must add a personal word. My acquaintance with Branner covers 52 years, the first two as fellow student and fraternity brother in Delta Upsilon, the next 30 as fellow teacher and coworker in science in Indiana and in California, three more as my successor and colleague in administration of the educational work to which I gave the best 25 years of my life, and, finally, 5 years of retirement from

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active responsibility to the congenial work of writing out of the fullness of experience. In all these years he lived up to his motto, "I can get along without the respect of my neighbors, but not without the respect of Number 1." And in maintaining self-respect he won the regard of his neighbors of whatever degree. A righteous life helps to strengthen all who come in contact with it. "There is always room for a man of force and he makes room for many."

DAVID STARR JORDAN.

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APPENDIXES.

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APPENDIX A.

CONSTITUTION OF THE NATIONAL ACADEMY.

[As amended and adopted April 17, 1872, and further amended April 20, 1875; April 21, 1881; April 19, 1882; April 18, 1883; April 19, 1888; April 18, 1895; April 20, 1899; April 17, 1902; April 18, 1906; November 20, 1906; April 17, 1907; November 20, 1907; April 20, 1911; Apr. 16, 1912; Apr. 21, 1915.]

PREAMBLE.

Empowered by the act of incorporation enacted by Congress, and approved by the President of the United States on the 3d day of March, A. D. 1863, and in conformity with amendments to said act approved July 14, 1870, June 20, 1884, and May 27, 1914, the National Academy of Sciences adopts the following amended constitution and rules:

ARTICLE I.—OF MEMBERS.

SECTION 1. The academy shall consist of members, honorary members, and foreign associates. Members must be citizens of the United States.

SEC. 2. Members who, from age or inability to attend the meetings of the academy, wish to resign the duties of active membership, may, at their own request, be transferred to the roll of honorary members by a vote of the academy.

SEC. 3. The academy may elect 50 foreign associates.

SEC. 4. Honorary members and foreign associates shall have the privilege of attending the meetings and of reading and communicating papers to the academy, but shall take no part in its business, shall not be subject to its assessments, and shall be entitled to a copy of the publications of the academy.

ARTICLE II.—OF THE OFFICERS.

SECTION 1. The officers of the academy shall be a president, a vice president, a foreign secretary, a home secretary, and a treasurer, all of whom shall be elected for a term of four years, by a majority of votes present, at the first stated meeting after the expiration of the current terms, provided that existing officers retain their places until their successors are elected. In case of a vacancy, the election for four years shall be held in the same manner at the meeting when such

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vacancy occurs, or at the next stated meeting thereafter, as the academy may direct. A vacancy in the office of treasurer or home secretary may, however, be filled by appointment of the president of the academy until the next stated meeting of the academy.

SEC. 2. The officers of the academy, together with six members to be elected by the academy, shall constitute a council for the transaction of such business as may be assigned to them by the constitution or the academy.

SEC. 3. The president of the academy, or, in case of his absence or inability to act, the vice president, shall preside at the meetings of the academy and of the council; shall name all committees except such as are otherwise especially provided for; shall refer investigations required by the Government of the United States to members especially conversant with the subjects and report thereon to the academy at its meeting next ensuing; and, with the council, shall direct the general business of the academy.

It shall be competent for the president, in special cases, to call in the aid, upon committees, of experts or men of special attainments not members of the academy.

The president shall be, ex officio, a member of all committees empowered to consider questions referred to the academy by the Government of the United States.

SEC. 4. The foreign and home secretaries shall conduct the correspondence proper to their respective departments, advising with the president and council in cases of doubt, and reporting their action to the academy at one of the stated meetings in each year.

It shall be the duty of the home secretary to give notice to the members of the place and time of all meetings, of all nominations for membership, and of all proposed amendments to the constitution.

It shall be the duty of the home secretary to keep the minutes of each business and scientific session, and after approval to enter these upon the permanent records of the academy.

SEC. 5. The treasurer shall attend to all receipts and disbursements of the academy, giving such bond and furnishing such vouchers as the council may require. He shall collect all dues, assessments, and subscriptions, and keep a set of books showing a full account of receipts and disbursements and the condition of all funds of the academy. He shall be the custodian of the corporate seal of the academy.

ARTICLE III.—OF THE MEETINGS.

SECTION 1. The academy shall hold one stated meeting, called the annual meeting, in April of each year in the city of Washington, and another stated meeting, called the autumn meeting, at a place to be determined by the council. The council shall also have power to fix the date of each meeting.

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Special business meetings of the academy may be called, by order of eight members of the council, at such place and time as may be designated in the call.

Special scientific meetings of the academy may be held at times and places to be designated by a majority of the council.

SEC. 2. The names of the members present at each session of a meeting shall be recorded in the minutes, and 20 members shall constitute a quorum for the transaction of business.

SEC. 3. Scientific sessions of the academy, unless otherwise ordered by a majority of the members present, shall be open to the public; sessions for the transaction of business shall be closed.

SEC. 4. Stated meetings of the council shall be held during the stated or special meetings of the academy, and four members shall constitute a quorum for the transaction of business. Special meetings of the council may be convened at the call of the president and two members of the council, or of four members of the council.

SEC. 5. No member whose dues are in arrears shall vote at any business meeting of the academy.

ARTICLE IV.—OF ELECTIONS AND REGULATIONS.

SECTION 1. All elections of officers and members shall be by ballot, and each election shall be held separately.

SEC. 2. The time for holding an election of officers shall be fixed by the academy at least one day before the election is held.

SEC. 3. The election of six members of the council shall be as follows:

At the annual meeting in April, 1907, six members of the council to be elected, of whom two shall serve for three years, two for two years, and two for one year, their respective terms to be determined by lot. Each year thereafter the terms of two members shall expire, and their successors, to serve for three years, shall be elected at the annual meeting in each year.

SEC. 4. The academy shall be divided by the council into sections representing the principal branches of scientific research. Each section shall elect its own chairman, who shall serve for three years. the chairman shall be responsible to the academy for the work of his section.

Nominations to membership in the academy shall be made in writing and approved by a majority of the members of the section on the branch of research in which the person nominated is eminent, or by a majority of the council in case there is no section on the subject. The nomination shall be sent to the home secretary by the chairman of the section before January 1 of the year in which the election is to be held, and each nomination shall be accompanied by a list of the principal contributions of the nominee to science. This list shall

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be printed by the home secretary for distribution among the members of the academy.

SEC. 5. Election of members shall be held at the annual meeting in Washington in the following manner: There shall be two ballots—a preference ballot, which may be prepared either before or at the annual meeting, and must be transmitted to the home secretary, and a final ballot, to be taken at the meeting.

Preference ballot.—Each member may inscribe on a ballot not more than 15 names of nominees selected from the submitted list. A list of the nominees shall then be prepared, on which the names shall be entered in the order of the number of votes received by each. In case two or more nominees have the same number of votes on this preference list, the order in which they shall be placed on the list shall be determined by a majority vote of members present.

Final ballot.—A vote shall first be taken on the nominee who appears first on the preference list, and he shall be declared elected if he receive two-thirds of the votes cast and not less than 25 votes in all. A vote shall then be taken in similar manner on the nominee standing second on the preference list, and so on until all the nominees on the preference list shall have been acted on, or until 15 nominees shall have been elected, or until the total membership of the academy shall have reached 250.

Not more than 15 members shall be elected at one annual meeting.

Before and during elections a discussion of the merits of nominees will be in order.

SEC. 6. Every member elect shall accept his membership, personally or in writing, before the close of the next stated meeting after the date of his election. Otherwise, on proof that the secretary has formally notified him of his election, his name shall not be entered on the roll of members.

SEC. 7. Foreign associates may be nominated by the council and may be elected at the annual meeting by a two-thirds vote of the members present.

SEC. 8. A diploma, with the corporate seal of the academy and the signatures of the officers, shall be sent by the appropriate secretary to each member on his acceptance of membership, and to foreign associates on their election.

SEC. 9. Resignations shall be addressed to the president and acted on by the academy.

SEC. 10. Whenever a member has not paid his dues for four successive years, the treasurer shall report the fact to the council, which may report the case to the academy with the recommendation that the person thus in arrears be declared to have forfeited his membership. If this recommendation be approved by two-thirds of the members present, the said person shall no longer be a member of the academy and his name shall be dropped from the roll.

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ARTICLE V.—SCIENTIFIC COMMUNICATIONS, PUBLICATIONS, AND REPORTS.

SECTION 1. Communications on scientific subjects shall be read at scientific sessions of the academy, and papers by any member may be read by the author or by any other member, notice of the same having been previously given to the secretary.

SEC. 2. Any member of the academy may read a paper from a person who is not a member, and shall not be considered responsible for the facts or opinions expressed by the author, but shall be held responsible for the propriety of the paper.

Persons who are not members may read papers on invitation of the council or of the committee of arrangements.

SEC. 3. The academy may provide for the publication, under the direction of the council, of proceedings, scientific memoirs, biographical memoirs, and reports.

The proceedings shall include the transcations of the academy, brief original announcements of the results of scientific investigations made by members of the academy or others, together with short original articles giving a comprehensive survey of the more important scientific researches currently made by American investigators, and other matters of general scientific interest.

The scientific memoirs shall provide opportunity for the publication of longer and more detailed scientific investigations.

The biographical memoirs shall contain an appropriate record of the life and work of the deceased members of the academy.

An annual report shall be presented to Congress by the president and shall contain the annual reports of the treasurer and the auditing committee, a suitable summary of the reports of the committees in charge of trust funds, and a record of the activities of the academy for the calendar year immediately preceding, and other appropriate matter. This report shall be presented to Congress by the president after authorization by the council. It shall also be presented to the academy at the annual meeting next following.

The treasurer shall prepare a full report of the financial affairs of the academy at the end of the fiscal year. This report shall be submitted to the council for approval and afterwards presented to the academy at the next stated meeting. He shall also prepare a supplementary financial statement to December 31 of the ensuing fiscal year for presentation at the annual meeting.

SEC. 4. Propositions for investigations or reports by the academy shall be submitted to the council for approval, except those requested by the Government of the United States, which shall be acted on by the president, who will in such cases report their results to the Government as soon as obtained and to the academy at its next following stated meeting.

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SEC. 5. The advice of the academy shall be at all times at the disposition of the Government upon any matter of science or art within its scope.

ARTICLE VI.—OF THE PROPERTY OF THE ACADEMY.

SECTION 1. All investments and reinvestments of either principal or accumulations of income of the trust and other funds of the academy shall be made by the treasurer, with the approval of the finance committee, in the corporate name of the academy, in the manner and in the securities designated or specified in the instruments creating the several funds, or, in the absence of such designation or specification, in bonds of the United States or of the several States, or in bonds or notes secured by first mortgages on real estate, in investments legal for savings banks under the laws of Massachusetts or New York, or in other bonds recommended to the treasurer by the fiscal advisers of the academy.

The treasurer may invest the capital of all trust funds of the academy which are not required by the instruments creating such funds to be kept separate and distinct, in a consolidated fund, and shall apportion the income received from such consolidated fund among the various funds composing the same in the proportion that each of said funds shall bear to the total amount of funds so invested; provided, however, that the treasurer shall at all times keep accurate accounts showing the amount of each trust fund, the proportion of the income from the consolidated fund to which it is entitled, and the expenses and disbursements properly chargeable to such fund.

SEC. 2. The council shall at its annual meeting in each year designate one bank or trust company in Washington, D. C., and one in New York City to act, when requested by the treasurer, as the fiscal advisers of the academy.

SEC. 3. The treasurer shall have authority, with the approval of the finance committee, to sell, transfer, convey, and deliver in the corporate name and for the benefit of the academy any stocks, bonds, or other securities standing in the corporate name.

SEC. 4. No contract shall be binding upon the academy which has not been first approved by the council.

SEC. 5. The assessments required for the support of the academy shall be fixed by the academy on the recommendation of the council and shall be payable within the calendar year for which they are assessed.

ARTICLE VII.—OF TRUST FUNDS AND THEIR ADMINISTRATION.

SECTION 1. Devises, bequests, donations, or gifts having for their object the promotion of science or the welfare of the academy may

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be accepted by the council for the academy. Before the acceptance of any such trust the council shall consider the object of the trust and all conditions or specifications attaching thereto. The council shall make a report of its action to the academy.

SEC. 2. Medals and prizes may be established in accordance with the provisions of trusts or by action of the academy.

SEC. 3. Unless otherwise provided by the deed of gift, the income of each trust fund shall be applied to the objects of that trust by the action of the academy on the recommendation of a standing committee on that fund.

ARTICLE VIII.—OF ADDITIONS AND AMENDMENTS.

Additions and amendments to the constitution shall be made only at a stated meeting of the academy. Notice of a proposition for such a change must be submitted to the council, which may amend the proposition, and shall report thereon to the academy. Its report shall be considered by the academy in committee of the whole for amendment.

The proposition as amended, if adopted in committee of the whole, shall be voted on at the next stated meeting, and if it receives two-thirds of the votes cast it shall be declared adopted.

Absent members may send their votes on pending changes in the constitution to the home secretary in writing, and such votes shall be counted as if the members were present.

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APPENDIX B.

RULES.

[In accordance with a resolution of the academy, taken at its meeting on April 21, 1915, the rules are arranged in groups and each group is numbered to correspond with the article of the constitution to which it relates.]

I.

1. The holders of the medal for eminence in the application of science to the public welfare shall be notified, like members, of the meetings of the academy, and invited to participate in its scientific sessions.

II.

1. The proper secretary shall acknowledge all donations made to the academy, and shall at once report them to the council for its consideration.

2. The home secretary shall be the custodian of all books, apparatus, archives, and collections not explicitly assigned to other care.

3. The home secretary shall keep a record of all grants of money or awards of prizes or medals made from trust funds of the academy. The assistant secretary, who may be a nonmember of the academy, shall receive a salary to be fixed by the council. The record for each grant of money shall include the following items: Name of fund, date and number of the grant, name and address of recipient, amount of grant and date or dates of payment, purpose of grant, record of report of progress, and resulting publications.

4. The treasurer shall keep the home secretary informed of all warrants received from directors of trust funds not controlled by the academy and of the date or dates of payment of all warrants.

5. The treasurer is authorized to defray, when approved by the president, all the proper expenses of committees appointed to make scientific investigations at the request of departments of the Government, and in each case to look to the department requesting the investigation for reimbursement to the academy.

6. The treasurer is authorized to act as the treasurer ex officio of the National Research Council.

7. The treasurer shall have the assistance of a salaried and bonded officer, the bursar, who shall be chosen by the finance committee and be directly responsible to the treasurer.

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III.

1. The annual meeting of the academy shall begin on the fourth Monday of April. At the business sessions of the academy the order of procedure shall be as follows:

(1) Chair taken by the president, or, in his absence, by the vice president.
(2) Roll of members called by home secretary (first session of the meeting only).
(3) Minutes of the preceding session read and approved.
(4) Stated business.
(5) Reports of president, secretaries, treasurer, and committees.
(6) Business from council.
(7) Other business.

2. The rules of order of the academy shall be those of the Senate of the United States, unless otherwise provided by the constitution or rules of the academy.

3. In the absence of any officer a member shall be chosen to perform his duties temporarily, by a plurality of viva voce votes, upon open nomination.

4. At each meeting the president shall announce the death of any members since the preceding meeting. As soon as practicable thereafter he shall designate a member to write—or to secure from some other source approved by the president—a biographical notice of each deceased member.

5. A local committee of five members, appointed for each meeting, and the home secretary shall together constitute the committee of arrangements, of which the home secretary shall be chairman.

It shall be the duty of the committee of arrangements to prepare the scientific program for the annual meeting, and for this purpose it shall be empowered to solicit papers from members or others. It shall also be empowered to ascertain the length of time required for reading papers to be presented at the scientific sessions of the academy, and, when it appears advisable, to limit the time to be occupied in their presentation or discussion.

The committee of arrangements shall meet not less than two months previous to each meeting. It shall prepare the detailed program of each day, and in general shall have charge of all business and scientific arrangements for the meeting for which it is appointed.

6. No paper requiring more than 15 minutes for its presentation shall be accepted unless by invitation of the committee of arrangements.

No speaker shall occupy more than 30 minutes for presentation of papers during the scientific sessions of a single meeting of the academy, except by invitation of the committee of arrangements.

Time shall not be extended except by vote of the academy and then not to exceed five minutes. The presiding officer shall warn speakers two minutes before the expiration of their time.

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The discussion of individual papers shall be limited not to exceed five minutes and the total time for discussion by any one speaker for all scientific sessions in any one meeting shall not exceed 15 minutes, unless approved by the academy.

No paper shall be entered upon the printed program of scientific sessions unless the title is in the hands of the committee of arrangements at least two weeks in advance of the meeting. In the event that titles are received later, they shall be placed in order of receipt at the end of the list and read, if there is time. Such supplementary titles shall be conspicuously posted.

IV.

1. The term of service of each chairman of a section shall be three years, to date from the closing session of the April meeting next following his election. Chairmen of sections shall be chosen by mail ballot, the member receiving the highest number of votes cast to be deemed elected. It shall be the duty of each retiring chairman to conduct the election of his successor and to report the result of the election to the home secretary before the April meeting at which his term of service expires. Should any section fail to elect a chairman before November 1, the president is empowered to appoint a temporary chairman to serve until the April meeting next following. No chairman shall be eligible for reelection for two consecutive terms.

2. The chairman of each section of the academy shall submit to the members of his section, not later than November 1 of each year, a ballot containing the names of all those persons who received not less than two votes in the nominating ballot of the preceding year and of any other persons who were newly proposed for consideration at that time. Each member of the section shall be expected to return this ballot to the chairman within two weeks with his signature and with crosses placed against the names of those persons whom he is prepared to indorse for nomination. Each member may also write upon the ballot in a place provided for the purpose any new names which he desires to have included in the ballot to be submitted to the section in the following year. The vote resulting from this ballot shall be regarded as informal.

The chairman shall then submit to the members of his section a new ballot showing the results of the informal vote; and each member shall be expected to return this ballot to the chairman with his signature and with crosses placed against the names of those persons whom he will indorse for nomination. In order to secure an adequate number of nominations, the chairman, when necessary, shall obtain by personal solicitation a fuller vote of his section or shall submit to the section a supplementary formal ballot.

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The chairman shall then certify to the home secretary, prior to January 1, the names of those persons who have been voted for on the formal ballots by a majority of the members of the section, and shall furnish him a list of the publications of these nominees, as required by the constitution.

3. Nominations for membership shall give the full name, residence, and the official positions successively held by the candidate, in addition to the list of his contributions to science required by the constitution.

4. Preference ballots for election of members shall be sealed in a blank envelope, which shall be inclosed in another bearing the name of the sender, and which shall be addressed to the home secretary. Such envelopes shall be opened only by the tellers. If in any case the tellers are unable to determine who cast a ballot, or if the latter contains more names than are to be voted for, the ballot shall be rejected, but minor defects in a ballot shall be disregarded when the intent of the voter is obvious.

5. All discussions of the claims and qualifications of nominees at meetings of the academy shall be held strictly confidential, and remarks and criticisms then made may be communicated to no person who was not a member of the academy at the time of the discussion.

V.

1. The publication of the Proceedings shall be under the general charge of the council, which shall have final jurisdiction upon all questions of policy relating thereto.

The National Academy of Sciences and the National Research Council shall cooperate in the publication of the Proceedings, beginning with Volume VII.

2. Memoirs may be presented at any time to the home secretary, who shall report the date of their reception at the next session; but no memoir shall be published unless it has been read or presented by title before the academy.

Before publication all biographical and scientific memoirs must be referred to the committee on publication, who may, if they deem best, refer any memoir to a special committee, appointed by the president, to determine whether the same should be published by the academy.

3. Memoirs shall date, in the records of the academy, from the date of their presentation to the academy, and the order of their presentation shall be so arranged by the secretary that, so far as may be convenient, those upon kindred topics shall follow one another.

4. The annual report of the treasurer shall contain:

(1) A concise statement of the source, object, and amount of all trust funds of the academy.

(2) A condensed statement of receipts and expenditures.

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(3) A statement of assets and liabilities.
(4) Accounts with individual funds.
(5) Such other matter as he considers appropriate.

5. The accounts of the treasurer shall, between July 1 and August 1 of each year, be audited under the direction of a committee of three members to be appointed by the president at the annual meeting of the academy. It shall be the duty of the auditing committee to verify the record of receipts and disbursements maintained by the treasurer and the agreement of book and bank balances; to examine all securities in the custody of the treasurer and to compare the stated income of such securities with the receipts of record; to examine all vouchers covering disbursements for account of the academy, including the National Research Council, and the authority therefor, and to compare them with the treasurer's record of expenditures; to examine and verify the account of the academy with each trust fund. The auditing committee may employ an expert accountant to assist the committee in the examination of the books of the treasurer. The annual report of the treasurer shall be published with that of the president to Congress. The reports of the treasurer and auditing committee shall be presented to the academy at the autumn meeting, and shall be published with that of the president to Congress. They shall be distributed to the members in printed form at the annual meeting.

VI.

1. All apparatus and other materials of permanent value purchased with money from any grant from a trust fund shall be the property of the academy unless specific exception is made in the grant or by subsequent action of the council or the directors of the trust fund concerned. Receipts for all such property shall be signed by the grantee and shall be forwarded to the home secretary. All apparatus and unused material of value acquired in this way shall be delivered to the home secretary on completion of the investigation for which the grant was made, or at any time on demand of the council, and the home secretary shall give an appropriate release therefor.

2. The books, apparatus, archives, and other collections of the academy shall be deposited in some safe place in the city of Washington. A list of the articles so deposited shall be kept by the home secretary, who is authorized to employ a clerk to take charge of them.

3. A stamp corresponding to the corporate seal of the academy shall be kept by the secretaries, who shall be responsible for the due markings of all books and other objects to which it is applicable.

Labels or other proper marks of similar device shall be placed upon objects not admitting of the stamp.

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4. The fiscal year of the academy shall end on June 30 of each year.

5. The standing committee on finance shall consist of the president of the academy ex officio, the treasurer ex officio as chairman, and five members to be appointed annually by the president, two of whom may be nonmembers of the academy.

That a budget committee on the expenses of the National Academy and the National Research Council, to consist of the president of the academy, the chairman of the National Research Council, and the treasurer of the National Academy of Sciences and the National Research Council, be appointed and the president of the academy act as chairman.

VII.

1. Standing committees of the academy on trust funds the income of which is applied to the promotion of research shall consist of three or five members. In order to secure rotation in office in such committees, when not in conflict with the provisions of the deeds of gift, the term of service on a committee of three members shall be three years; on a committee of five members the term shall be five years.

2. The annual reports of the committees on research funds shall, so far as the academy has authority to determine their form, give a current number to each award, stating the name, position, and address of the recipient; the subject of research for which the award is made, and the sum awarded; and in later annual reports the status of the work accomplished under each award previously made shall be announced, until the research is completed, when announcement of its completion and, if published, the title and place of publication shall be stated, and the record of the award shall be reported as closed.

VIII.

1. Any rule of the academy may be amended, suspended, or repealed on the written motion of any two members, signed by them, and presented at a stated meeting of the academy, provided the same shall be approved by a majority of the members present.

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APPENDIX C.

ORGANIZATION OF THE ACADEMY, 1922.

	Expiration of term.
Walcott, Charles D., president	April, 1923
Michelson, A. A., vice president	April, 1923
Millikan, R. A., foreign secretary	April, 1926
Abbot, C. G., home secretary	April, 1923
Ransome, F. L., treasurer	April, 1923

ADDITIONAL MEMBERS OF COUNCIL.

1920–1923.

Day, A. L. — Morgan, T. H.

1921–1924.

Pearl, Raymond — Hale, George E.

1922–1925.

Ames, J. S. — Dunn, Gano

SECTIONS.

1. MATHEMATICS.

Birkhoff, G. D.
Blichfeldt, H. F.
Bliss, G. A.
Bolza, Oskar
Dickson, L. E.
Eisenhart, L. P.
Kasner, Edward
Miller, George A.
Moore, E. H.
Osgood, W. F.
Story, W. E.
Van Vleck, E. B.
Veblen, Oswald (chairman, 1925).
White, H. S.
Wilczynski, E. J.

2. ASTRONOMY.

Abbot, C. G. (chairman, 1923).
Adams, W. S.
Aitken, R. G.
Barnard, E. E.
Campbell, W. W.
Comstock, G. C.
Curtis, H. D.
Elkin, W. L.
Frost, E. B.
Hale, G. E.
Leuschner, A. O.
Moulton, F. R.
Russell, H. N.
Schlesinger, Frank
Seares, F. H.
Slipher, V. M.
Stebbins, Joel
Wright, W. H.

3. PHYSICS.

Ames, J. S.
Barus, Carl
Bridgman, P. W.
Burgess, G. K.
Crew, Henry
Duane, William
Hall, E. H.
Hastings, C. S.
Hayford, J. F.
Lyman, Theodore
Mendenhall, C. E.
Mendenhall, T. C.
Merritt, Ernest
Michelson, A. A.
Miller, D. C.
Millikan, R. A.
Nichols, E. F.
Nichols, E. L.
Pierce, G. W.
Pupin, M. I.
Stratton, S. W.
Thomson, Elihu
Trowbridge, Augustus (chairman, 1923).
Trowbridge, John
Webster, A. G.
Wilson, Edwin B.
Wood, R. W.
Woodward, R. S.

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4. ENGINEERING.

Abbot, H. L.
Carty, J. J. (chairman, 1923).
Dunn, Gano
Durand, W. F.
Emmet, W. LeRoy
Freeman, J. R.
Hoover, Herbert
Jewett, F. B.
Kennelly, A. E.
Ryan, H. J.
Squier, G. O.
Stillwell, L. B.
Swasey, Ambrose
Taylor, D. W.

5. CHEMISTRY.

Bancroft, W. D.
Baxter, G. P.
Bogert, M. T.
Boltwood, B. B.
Chandler, C. F.
Clarke, F. W.
Franklin, E. C.
Gomberg, Moses
Gooch, F. A.
Harkins, W. D.
Hillebrand, W. F.
Hulett, G. A.
Jackson, C. L.
Johnson, T. B.
Kohler, E. P.
Langmuir, Irving
Lewis, G. N.
Michael, Arthur
Morley, E. W.
Noyes, A. A.
Noyes, W. A. (chairman, 1923).
Osborne, T. B.
Remsen, Ira
Richards, T. W.
Smith, Edgar F.
Stieglitz, Julius
Wells, H. L.
Whitney, W. R.

6. GEOLOGY AND PALEONTOLOGY.

Berry, E. W.
Chamberlin, T. C.
Clarke, J. M.
Cross, Whitman
Dall, W. H.
Dana, E. S.
Davis, W. M.
Day, A. L. (chairman, 1924).
Kemp, J. F.
Leith, C. K.
Lindgren, Waldemar
Merriam, J. C.
Merrill, G. P.
Osborn, H. F.
Pumpelly, Raphael
Ransome, F. L.
Reid, H. F.
Schuchert, Charles
Scott, W. B.
Ulrich, E. O.
Vaughan, T. W.
Walcott, C. D.
Washington, H. S.
White, David
Willis, Bailey

7. BOTANY.

Bailey, L. H. (chairman, 1924).
Britton, N. L.
Campbell, D. H.
Coulter, J. M.
Goodale, G. L.
Harper, R. A.
Jones, L. R.
Osterhout, W. J. V.
Robinson, B. L.
Sargent, C. S.
Setchell, W. A.
Smith, Erwin F.
Thaxter, Roland
Trelease, William

8. ZOOLOGY AND ANIMAL MORPHOLOGY.

Calkins, G. N.
Castle, W. E.
Chapman, F. M.
Conklin, E. G.
Davenport, C. B.
Donaldson, H. H.
Forbes, S. A.
Harrison, R. G. (chairman, 1925).
Herrick, C. J.
Howard, L. O.
Jennings, H. S.
Kofoid, C. L.
Lillie, F. R.
McClung, C. E.
Mark, E. L.
Morgan, T. H.
Morse, E. S.
Parker, G. H.
Pearl, Raymond
Ridgway, Robert
Stockard, C. R.
Verrill, A. E.
Wheeler, W. M.
Wilson, Edmund B.

9. PHYSIOLOGY AND PATHOLOGY.

Abel, J. J.
Benedict, F. G.
Cannon, W. B.
Carlson, A. J.
Chittenden, R. H.
Cole, Rufus
Councilman, W. T.
Cushing, Harvey
Erlanger, J.
Flexner, Simon
Folin, Otto
Halsted, W. S.

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Hektoen, Ludvig	Loeb, Jacques	Prudden, T. M.
Henderson, L. J.	Lusk, Graham (chairman. 1925).	Smith, Theobald
Howell, W. H.		Van Slyke, D. D.
Hunt, Reid	MacCallum, W. G.	Vaughan, V. C.
Jones, Walter	McCollum, E. V.	Welch, W H.
Levene, P. A. T.	Mendel, L. B.	

10. ANTHROPOLOGY AND PSYCHOLOGY.

Angell, J. R.	Hall, G. S.	Seashore, C. E.
Boas, Franz	Holmes, W. H.	Thorndike, E. L.
Cattell, J. McK.	Hrdlicka, Ales	Woodworth, R. S.
Dewey, John	Merriam, C. H.	
Fewkes, J. W. (acting chairman).		

STANDING COMMITTEES.

ON WEIGHTS, MEASURES, AND COINAGE.

Stratton, S. W. (chairman).	Michelson, A. A.	Woodward, R. S.
Mendenhall, T. C.	Webster, A. G.	

ON SOLAR RESEARCH.

Hale, G. E. (chairman).	Michelson, A. A.	Nichols, E. L.
Campbell, W. W.		

ON PUBLICATION.

The President.	The Home Secretary.	Stratton, S. W.

EDITORIAL BOARD OF THE PROCEEDINGS.

The home secretary and the foreign secretary of the academy, the chairman of the executive board, and the permanent secretary of the National Research Council.

William Duane, 1923.	Gano Dunn, 1922.	N. M. Fenneman.
R. G. Harrison, 1923.	L. J. Henderson, 1922.	A. D. Flinn.
E. H. Moore, 1923.	W. J. V. Osterhout, 1922.	F. P. Gay.
F. Schlesinger, 1923.	J. M. Clarke.	F. R. Lillie.
W. M. Wheeler, 1923.	Raymond Dodge.	E. W. Washburn.
Arthur L. Day, 1922.		

ON COLLECTION OF HISTORICAL PORTRAITS, MANUSCRIPTS, INSTRUMENTS, ETC.

Walcott, C. D. (chairman).	Hale, G. E.	Pupin, M. I.
Clarke, F. W.		

FINANCE COMMITTEE.

Ransome, F. L. (chairman).	Dunn, Gano.	Walcott, C. D.
Cross, Whitman		

TRUST FUNDS.

THE BACHE FUND.

[$60,000.]

Researches in physical and natural science.

Harrison, R. G. (chairman).	Curtis, H. D.	Webster, A. G.

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THE WATSON FUND.

[$25,000.]

Watson medal and the promotion of astronomical research.

Leuschner, A. O. (chairman). Comstock, G. C. Elkins, W. L.

WATSON MEDAL AWARDS.

B. A. Gould, 1887.
Ed. Schoenfeld, 1889.
Arthur Auwers, 1891.
S. C. Chandler, 1894.
Sir David Gill, 1899.
J. C. Kapteyn, 1913.
A. O. Leuschner, 1915.

THE HENRY DRAPER FUND.

[$10,000.]

Draper medal and investigations in astronomical physics.

Campbell, W. W. (chairman), 1924. Abbot, C. G., 1926. Michelson, A. A., 1927.
Hale, G. E., 1923. Russell, H. N., 1925.

HENRY DRAPER MEDAL AWARDS.

S. P. Langley, 1886.
E. C. Pickering, 1888.
H. A. Rowland, 1890.
H. K. Vogel, 1893.
J. E. Keeler, 1899.
Sir Wm. Huggins, 1901.
George E. Hale, 1904.
W. W. Campbell, 1907.
C. G. Abbot, 1910.
H. Deslandres, 1913.
Joel Stebbins, 1915.
A. A. Michelson, 1916.
W. S. Adams, 1918.
Charles Fabry, 1919.
Alfred Fowler, 1920.
Pieter Zeeman, 1921.
H. N. Russell, 1922.

THE J. LAWRENCE SMITH FUND.

[$10,000.]

J. Lawrence Smith medal and investigations of meteoric bodies.

Cross, Whitman (chairman), 1927. Adams, W. S., 1924. Dana, E. S., 1923.
Schlesinger, F., 1925. Clarke, F. W., 1926.

J. LAWRENCE SMITH MEDAL AWARDS.

H. A. Newton, 1888.
George P. Merrill, 1922.

THE BARNARD MEDAL.[1]

Meritorious service to science.

Noyes, A. A. (chairman). Campbell, W. W. Nichols, E. F.
Morgan, T. H. Richards, T. W.

BARNARD MEDAL AWARDS.

Sir Ernest Rutherford, 1909.
Sir W. H. Bragg, 1914.
Albert Einstein, 1921.

[1] Every five years the committee recommends the person whom they consider most deserving of the medal, and upon the approval of the academy the name of the nominee is forwarded to the trustees of Columbia University, who administer the Barnard medal fund.

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THE BENJAMIN APTHORP GOULD FUND.

[$20,000.]

Researches in astronomy.

Moulton, F. R. (chairman). Barnard, E. E. Woodward, R. S.

THE WOLCOTT GIBBS FUND.

[$5,545.50.]

Chemical research.

Richards, T. W. Smith, Edgar F.

THE COMSTOCK FUND.

[$12,406.02.]

Researches in electricity, magnetism, and radiant energy.

Nichols, E. L. (chairman), 1923. Millikan, R. A., 1926. Whitney, W. R., 1924.
Carty, J. J., 1925. Crew, Henry, 1927.

COMSTOCK PRIZE AWARDS.

R. A. Millikan, 1913. S. J. Barnett, 1918.

THE MARSH FUND.

[$20,000.]

Original research in the natural sciences.

Merriam, J. C. (chairman), 1925. Clarke, J. M., 1923.

Schuchert, Charles, 1924.

THE AGASSIZ FUND.

[$50,000.]

General uses of the academy.

AGASSIZ MEDAL AWARDS.

Johan Hjort, 1913. Albert I, Prince of Monaco, 1918. C. D. Sigsbee, 1920.

THE MURRAY FUND.

[$6,000.]

Agassiz medal and contributions to oceanography.

Dall, W. H. (chairman), 1924. Davis, W. M., 1925. Mayor, A. G., 1923.

THE MARCELLUS HARTLEY FUND.

[$1,200.]

Medal for eminence in the application of science to the public welfare.

Stratton, S. W. (chairman), 1925. Pupin, M. I., 1924. Osborn, H. F., 1924.
Angell, J. R., 1925. Welch, W. H., 1923. Taylor, D. W., 1923.

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PUBLIC WELFARE MEDAL AWARDS.

(In memory of Marcellus Hartley.)

G. W. Goethals, 1914.
W. C. Gorgas, 1914.
Cleveland Abbe, 1916.
Gifford Pinchot, 1916.
S. W. Stratton, 1917.
Herbert Hoover, 1920.
C. W. Stiles, 1921.

THE DANIEL GIRAUD ELLIOT FUND.

[$8,000.]

Medal and honorarium for most meritorious work in zoology or paleontology published in each year.

Osborn, H. F. (chairman). [1] Lucas, F. A. Walcott, C. D.

DANIEL GIRAUD ELLIOT MEDAL AWARDS.

F. M. Chapman, 1918.
William Beebe, 1919.
Robert Ridgway, 1920.
Othenio Abel, 1921.

THE MARY CLARK THOMPSON FUND.

[$10,000.]

Medal for most important services to geology and paleontology.

Clarke, J. M. (chairman), 1925. Lindgren, W., 1923. Osborn, H. F., 1924.

MARY CLARK THOMPSON MEDAL AWARDS.

C. D. Walcott, 1921.

THE JOSEPH HENRY FUND.

[$40,000.]

To assist meritorious investigators, especially in the direction of original research.

Durand, W. F. (chairman). Davenport, C. B. Merriam, J. C.
Day, Arthur L. McClung, C. E.

[1] Not a member of the academy.

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MEMBERS OF THE NATIONAL ACADEMY OF SCIENCES.

June 30, 1922.

	Date of election.
Abbot, C. G., Smithsonian Institution, Washington, D. C.	1915
Abbot, H. L., 23 Berkeley Street, Cambridge 38, Mass.	1872
Abel, J. J., Johns Hopkins University, Baltimore, Md.	1912
Adams, W. S., Solar Observatory Office, Pasadena, Calif.	1917
Aitken, R. G., Lick Observatory, Mount Hamilton, Calif.	1918
Ames, J. S., Johns Hopkins University, Baltimore, Md.	1909
Angell, J. R., Yale University, New Haven, Conn.	1920
Bailey, L. H., Ithaca, N. Y.	1917
Bancroft, W. D., 7 East Avenue, Ithaca, N. Y.	1920
Barnard, E. E., Yerkes Observatory, Williams Bay, Wis.	1911
Barus, Carl, Brown University, Providence, R. I.	1892
Baxter, G. P., T. J. Coolidge, jr., Memorial Laboratory, Cambridge, Mass.	1916
Bell, A. Graham, 1331 Connecticut Avenue, Washington, D. C.	1883
Benedict, F. G., Nutrition Laboratory, Boston 17, Mass.	1914
Berry, E. W., Johns Hopkins University, Baltimore, Md.	1922
Birkhoff, G. D., Harvard University, Cambridge, Mass.	1918
Blichfeldt, H. F., Stanford University, Calif.	1920
Bliss, G. A., University of Chicago, Chicago, Ill.	1916
Boas, Franz, Columbia University, New York City	1900
Bogert, M. T., Columbia University, New York City	1916
Boltwood, B. B., Yale University, New Haven, Conn.	1911
Bolza, O., Reichsgrafenstr. 10, Freiburg, Germany	1909
Bridgman, P. W., Jefferson Physical Laboratory, Cambridge, Mass.	1918
Britton, N. L., New York Botanical Gardens, New York City	1914
Burgess, G. K., Bureau of Standards, Washington, D. C.	1922
Calkins, G. N., Columbia University, New York, N. Y.	1919
Campbell, D. H., Stanford University, Calif.	1910
Campbell, W. W., Lick Observatory, Mount Hamilton, Calif.	1902
Cannon, W. B., Harvard University, Cambridge, Mass.	1914
Carlson, A. J., University of Chicago, Chicago, Ill.	1920
Carty, J. J., American Telegraph & Telephone Co., New York City	1917
Castle, W. E., 186 Payson Road, Belmont, Mass.	1915
Cattell, James McK., Garrison, N. Y.	1901
Chamberlin, T. C., University of Chicago, Chicago, Ill.	1903
Chandler, C. F., Columbia University, New York City	1874
Chapman, F. M., American Museum, Natural History, New York City	1921
Chittenden, R. H., Sheffield Scientific School, New Haven, Conn.	1890
Clarke, F. W., United States Geological Survey, Washington, D. C.	1909
Clarke, J. M., State Museum, Albany, N. Y.	1909
Cole, Rufus, Rockefeller Hospital, New York City.	1922
Comstock, G. C., Washburn Observatory, Madison, Wis.	1899
Conklin, E. G., Princeton, N. J.	1908
Coulter, J. M., University of Chicago, Chicago, Ill.	1909
Councilman, W. T., Harvard Medical School, Boston, Mass.	1904
Crew, Henry, Northwestern University, Evanston, Ill.	1909

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	Date of election.
Cross, Whitman, 101 East Kirke Street, Chevy Chase, Md	1908
Curtis, H. D., Allegheny Observatory, Pittsburgh, Pa	1919
Cushing, Harvey, Harvard University, Cambridge, Mass	1917
Dall, W. H., Smithsonian Institution, Washington, D. C	1897
Dana, E. S., Yale University, New Haven, Conn	1884
Davenport, C. B., Cold Spring Harbor, N. Y	1912
Davis, W. M., 31 Hawthorn Street, Cambridge 38, Mass	1904
Day, A. L., 2801 Upton Street, Washington, D. C	1911
Dewey, John, Columbia University, New York City	1910
Dickson, L. E., University of Chicago, Chicago, Ill	1913
Donaldson, H. H., Wistar Institute of Anatomy, Philadelphia, Pa	1914
Duane, W., Harvard University, Cambridge, Mass	1920
Dunn, Gano, 43 Exchange Place, New York City	1919
Durand, W. F., Leland Stanford University, Calif	1917
Eisenhart, L. P., Princeton University, Princeton, N. J	1922
Elkin, W. L., 206 Livingston Street, New Haven, Conn	1917
Emmet, W. Le Roy, General Electric Co., Schenectady, N. Y	1921
Erlanger, Joseph, Washington University, St. Louis, Mo	1922
Fewkes, J. W., Bureau of American Ethnology, Washington, D. C	1914
Flexner, Simon, Rockefeller Institute, New York City	1908
Folin, Otto, Harvard Medical School, Boston, Mass	1916
Forbes, Stephen Alfred, Urbana, Ill	1918
Franklin, E. C., Leland Stanford University, Calif	1914
Freeman, John Ripley, Providence, R. I	1918
Frost, E. B., Yerkes Observatory, Williams Bay, Wis	1906
Gomberg, Moses, University of Michigan, Ann Arbor, Mich	1914
Gooch, Frank A., 291 Edwards Street, New Haven, Conn	1897
Goodale, George L., Harvard University, Cambridge, Mass	1890
Hale, George E., Solar Observatory Office, Pasadena, Calif	1902
Hall, Edwin H., Harvard University, Cambridge, Mass	1911
Hall, G. S., Clark University, Worcester, Mass	1915
Halsted, W. S., Johns Hopkins Medical School, Baltimore, Md	1917
Harkins, W. D., University of Chicago, Chicago, Ill	1921
Harper, R. A., Columbia University, New York City	1911
Harrison, Ross G., Yale University, New Haven, Conn	1918
Hastings, C. S., Yale University, New Haven, Conn	1889
Hayford, J. F., Northwestern University, Evanston, Ill	1911
Hektoen, Ludvig, 637 South Wood Street, Chicago, Ill	1918
Henderson, L. J., Harvard University, Cambridge, Mass	1919
Herrick, C. J., University of Chicago, Chicago, Ill	1918
Hillebrand, W. F., Bureau of Standards, Washington, D. C	1908
Holmes, W. H., United States National Museum, Washington, D. C	1905
Hoover, H. C., Secretary of Commerce, Washington, D. C	1922
Howard, L. O., United States Department of Agriculture, Washington, D. C	1916
Howell, W. H., School of Hygiene and Public Health, Baltimore, Md	1906
Hrdlička, Aleš, United States National Museum, Washington, D. C	1921
Hulett, G. A., Princeton University, Princeton, N. J	1922
Hunt, Reid, Harvard Medical School, Boston, Mass	1919
Jackson, Charles L., 383 Beacon Street, Boston, Mass	1883
Jennings, H. S., Johns Hopkins University, Baltimore, Md	1914
Jewett, F. B., Western Electric Co., New York, N. Y	1918
Johnson, T. B., Yale University, New Haven, Conn	1919

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	Date of election.
Jones, L. R., University of Wisconsin, Madison, Wis	1920
Jones, Walter, Johns Hopkins University, Baltimore, Md	1918
Kasner, Edward, Columbia University, New York City	1917
Kemp, James F., Columbia University, New York City	1911
Kennelly, A. E., Harvard University, Cambridge, Mass	1921
Kofoid, C. A., University of California, Berkeley, Calif	1922
Kohler, E. P., Harvard University, Cambridge, Mass	1920
Langmuir, Irving, General Electric Co., Schenectady, N. Y	1918
Leith, C. K., University of Wisconsin, Madison, Wis	1920
Leuschner, A. O., University of California, Berkeley, Calif	1913
Levene, P. A. T., Rockefeller Institute, New York City	1916
Lewis, G. N., University of California, Berkeley, Calif	1913
Lillie, F. R., University of Chicago, Chicago, Ill	1915
Lindgren, Waldemar, Massachusetts Institute of Technology, Cambridge, Mass	1909
Loeb, Jacques, Rockefeller Institute, New York City	1910
Lusk, Graham, Cornell University Medical College, New York City	1915
Lyman, Theodore, Harvard University, Cambridge, Mass	1917
MacCallum, W. G., Johns Hopkins Hospital, Baltimore, Md	1921
McClung, Clarence E., University of Pennsylvania, Philadelphia, Pa	1920
McCollum, E. V., Johns Hopkins Medical School, Baltimore, Md	1920
Mark, Edward L., 109 Irving Street, Cambridge, Mass	1903
Mendel, L. B., Yale University, New Haven, Conn	1913
Mendenhall, C. E., University of Wisconsin, Madison, Wis	1918
Mendenhall, T. C., 329 North Chestnut Street, Ravenna, Ohio	1887
Merriam, C. Hart, 1919 Sixteenth Street, Washington, D. C	1902
Merriam, J. C., Carnegie Institution, Washington, D. C	1918
Merrill, G. P., United States National Museum, Washington, D. C	1922
Merritt, Ernest, Cornell University, Ithaca, N. Y	1914
Michael, Arthur, 219 Parker Street, Newton Center, Mass	1889
Michelson, A. A., University of Chicago, Chicago, Ill	1888
Miller, D. C., Case School of Applied Science, Cleveland, Ohio	1921
Miller, G. A., University of Illinois, Urbana, Ill	1921
Millikan, R. A., California Institute of Technology, Pasadena, Calif	1915
Moore, E. H., University of Chicago, Chicago, Ill	1901
Morgan, T. H., Columbia University, New York City	1909
Morley, Edward W., West Hartford, Conn	1897
Morse, Edward S., Salem, Mass	1876
Moulton, F. R., University of Chicago, Chicago, Ill	1910
Nichols, E. L., Cornell University, Ithaca, N. Y	1901
Nichols, E. F., Nela Research Laboratory, Cleveland, Ohio	1908
Noyes, A. A., California Institute of Technology, Pasadena, Calif	1905
Noyes, W. A., University of Illinois, Urbana, Ill	1910
Osborn, H. F., American Museum of Natural History, New York City	1900
Osborne, T. B., Agricultural Experiment Station, New Haven, Conn	1910
Osgood, W. F., Harvard University, Cambridge, Mass	1904
Osterhout, W. J. V., Harvard University, Cambridge, Mass	1919
Parker, G. H., 16 Berkeley Street, Cambridge, Mass	1913
Pearl, Raymond, 625 St. Paul Street, Baltimore, Md	1916
Pierce, G. W., Harvard University, Cambridge, Mass	1920
Prudden, T. M., 160 West Fifty-ninth Street, New York City	1901
Pumpelly, Raphael, Gibbs Avenue, Newport, R. I	1872
Pupin, M. I., Columbia University, New York City	1905

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	Date of election.
Ransome, F. L., United States Geological Survey, Washington, D. C	1914
Reid, H. F., Johns Hopkins University, Baltimore, Md	1912
Remsen, Ira, Johns Hopkins University, Baltimore, Md	1882
Richards, T. W., Wolcott Gibbs Memorial Laboratory, Cambridge, Mass	1899
Ridgway, Robert, 1030 South Morgan Street, Olney, Ill	1917
Robinson, B. L., Harvard University, Cambridge, Mass	1921
Russell, H. N., Princeton University, Princeton, N. J	1918
Ryan, H. J., Stanford University, Stanford, Calif	1920
Sargent, C. S., Arnold Arboretum, Jamaica Plains, Mass	1895
Schlesinger, Frank, Yale University Observatory, New Haven, Conn	1916
Schuchert, Charles, Yale University, New Haven, Conn	1910
Scott, W. B., Princeton University, Princeton, N. J	1906
Seares, F. H., Mount Wilson Observatory, Pasadena, Calif	1919
Seashore, C. E., State University of Iowa, Iowa City, Iowa	1922
Setchell, W. A., University of California, Berkeley, Calif	1919
Slipher, V. M., Lowell Observatory, Flagstaff, Ariz	1921
Smith, Alexander, Columbia University, New York City	1915
Smith, Edgar F., University of Pennsylvania, Philadelphia, Pa	1899
Smith, Erwin F., Bureau of Plant Industry, Washington, D. C	1913
Smith, Theobald, Rockefeller Institute for Medical Research, Princeton, N. J	1908
Squier, G. O., Chief Signal Officer, United States Army, Washington, D. C	1919
Stebbins, Joel, Washburn Observatory, Madison, Wis	1920
Stieglitz, Julius, University of Chicago, Chicago, Ill	1911
Stillwell, L. B., 143 Liberty Street, New York City	1921
Stockard, C. R., Cornell University Medical School, New York City	1922
Story, William E., Clark University, Worcester, Mass	1908
Stratton, S. W., Bureau of Standards, Washington, D. C	1917
Swasey, Ambrose, 5701 Carnegie Avenue, Cleveland, Ohio	1922
Taylor, D. W., Department of the Navy, Washington, D. C	1918
Thaxter, Roland, Harvard University, Cambridge, Mass	1912
Thomson, Elihu, Swampscott, Mass	1907
Thorndike, E. L., Columbia University, New York City	1917
Trelease, William, University of Illinois, Urbana, Ill	1902
Trowbridge, Augustus, Princeton University, Princeton, N. J	1919
*Trowbridge, John, Harvard University, Cambridge, Mass	1878
Ulrich, E. O., United States Geological Survey, Washington, D. C	1917
Van Slyke, D. D., Rockefeller Institute, New York City	1921
Van Vleck, E. B., University of Wisconsin, Madison, Wis	1911
Vaughan, T. W., United States National Museum, Washington, D. C	1921
Vaughan, V. C., University of Michigan, Ann Arbor, Mich	1915
Veblen, Oswald, Princeton University, Princeton, N. J	1919
Verrill, A. E., Whitney Avenue and Central Avenue, New Haven, Conn	1872
Walcott, C. D., Smithsonian Institution, Washington, D. C	1896
Washington, H. S., Geophysical Laboratory, Washington, D. C	1921
Webster, Arthur G., Clark University, Worcester, Mass	1903
Welch, William H., 807 St. Paul Street, Baltimore, Md	1895
Wells, Horace L., Yale University, New Haven, Conn	1903
Wheeler, W. M., Harvard University, Cambridge, Mass	1912
White, David, United States Geological Survey, Washington, D. C	1912
White, H. S., Vassar College, Poughkeepsie, N. Y	1915
Whitney, W. R., General Electric Co., Schenectady, N. Y	1917
Wilczynski, E. J., University of Chicago, Chicago, Ill	1919

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	Date of election.
Willis, Bailey, Leland Stanford University, Stanford, Calif.	1920
Wilson, Edmund B., Columbia University, New York City	1899
Wilson, Edwin B., 240 Longwood Avenue, Boston 17, Mass	1919
Wood, R. W., Johns Hopkins University, Baltimore, Md	1912
Woodward, Robert S., Carnegie Institution, Washington, D. C	1896
Woodworth, R. S., Columbia University, New York City	1921
Wright, W. H., Lick Observatory, Mount Hamilton, Calif	1922

HONORARY MEMBER.

Smith, Sidney I., Yale University, New Haven, Conn	1884

FOREIGN ASSOCIATES.

Adams, F. D., McGill University, Montreal, Canada	1920
Arrhenius, S. A., Nobelinstitut, Stockholm	1908
Barrois, Charles, Universite, Lille	1908
Bateson, W., John Innes Horticultural Institute, Merton Park, Surrey	1921
Brøgger, W. C., Universitet, Christiania	1903
De Vries, Hugo, Lunteren, Holland	1904
Deslandres, Henri, Astrophysical Observatory, Meudon	1913
Dewar, Sir James, University, Cambridge, England	1907
Eijkman, Christian, University of Utrecht, Utrecht, Holland	1921
Einstein, Albert, University of Berlin, Berlin, Germany	1922
Forsyth, A. R., Imperial College of Science and Technology, London	1907
Geikie, Sir Archibald, Haslemere, Surrey	1901
Groth, Paul von, Universität, Munich	1905
Heim, Albert, Zurich	1913
Hilbert, David, Universität, Gottingen	1907
Klein, Felix, Universität, Gottingen	1898
Kossel, Albrecht, Heidelberg	1913
Küstner, Karl Friedrich, Bonn	1913
Lacroix, F. A. A., Musee d'Histoire Naturelle, Paris	1920
Lankester, Sir E. Ray, 44 Oakley Street, Chelsea, S. W. 3, London	1903
Larmor, Sir Joseph, St. Johns College, Cambridge	1908
Lorentz, Hendrik Anton, Rijks Universiteit, Leiden	1906
Onnes, Heike Kammerlingh, University of Leiden, Leiden	1920
Ostwald, Wilhelm, Grossbothen bei Leipzig	1906
Pavlov, I. P., Institute for Experimental Medicine, Petrograd	1908
Penck, Albrecht, Universität, Berlin	1909
Picard, Charles Emile, Universite, Paris	1903
Prain, Sir David, Royal Botanic Gardens, Kew, Surrey	1920
Ramon y Cajal, Santiago, University of Madrid, Madrid	1920
Rutherford, Sir Ernest, Newnham Cottage, Queen's Road, Cambridge	1911
Schuster, Sir Arthur, Yeldall, Twyford, Berkshire	1913
Seeliger, Hugo Ritter von, Universität, Munich	1908
Thomson, Sir Joseph, University, Cambridge	1903
Volterra, Vito, Universita, Rome	1911
Van der Waals, Johannes D., Amsterdam	1913
Wolf, Max F. J. C., Heidelberg	1913

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Medalists.

	Medal.	Year awarded.
Abel, Othenio [1]	Elliot	1921
Abbot, Charles Greeley	Draper	1910
Adams, Walter Sidney	Draper	1918
Barnett, Samuel Jackson [1]	Comstock	1915
Beebe, William [1]	Elliot	1919
Bragg, Sir William Henry [1]	Barnard	1914
Campbell, William Wallace	Draper	1907
Chapman, Frank Michler	Elliot	1918
Deslandres, Henri	Draper	1913
Einstein, Albert	Barnard	1921
Fabry, Charles [1]	Draper	1919
Fowler, Alfred [1]	Draper	1920
Goethals, George Washington [1]	Welfare	1914
Hale, George Ellery	Draper	1904
Hjort, Johan [1]	Agassiz	1913
Hoover, Herbert	Welfare	1920
Kapteyn, John C	Watson	1913
Leuschner, Armin Otto	Watson	1915
Margerie, Emmanuel de [1]	Thompson	1923
Merrill, George Perkins	Smith	1922
Michelson, Albert Abraham	Draper	1916
Millikan, Robert Andrews	Comstock	1913
Pinchot, Gifford [1]	Welfare	1916
Ridgway, Robert	Elliot	1920
Russell, Henry Norris	Draper	1922
Rutherford, Sir Ernest	Barnard	1909
Sigsbee, Rear Admiral Charles Dwight, U. S. Navy [1]	Agassiz	1920
Stebbins, Joel	Draper	1915
Stiles, Charles Wardell [1]	Welfare	1921
Stratton, Samuel Wesley	Welfare	1917
Walcott, Charles Doolittle	Thompson	1921
Zeeman, Pieter [1]	Draper	1921

[1] Not member or foreign associate of the academy.

Deceased members.

	Date of election.	Date of death.		Date of election.	Date of death.
Abbe, Cleveland	1878	Oct. 28, 1916	Brown-Sequard, Chas. E.	1868	Apr. 2, 1894
Agassiz, Alexander	1866	Mar. 27, 1910	Brush, George Jarvis	1868 [2]	Feb. 6, 1912
Agassiz, Louis	(1)	Dec. 14, 1873	Bumstead, Henry A.	1913 [2]	Dec. 31, 1920
Atkinson, George Francis	1918 [2]	Nov. 14, 1918	Casey, Thomas L.	1890	Mar. 25, 1896
Alexander, J. H.	(1)	Mar. 2, 1867	Caswell, Alexis	(1)	Jan. 8, 1877
Alexander, Stephen	(1)	June 25, 1883	Chandler, Seth Carlo	1888 [2]	Dec. 31, 1913
Allen, J. A.	1876 [2]	Aug. 29, 1921	Chauvenet, William	(1)	Dec. 13, 1877
Armsby, H. P.	1920 [2]	Oct. 19, 1921	Clark, Henry James	1872	July 1, 1879
Bache, Alexander Dallas	(1)	Feb. 14, 1867	Clark, William B.	1908	July 27, 1913
Baird, Spencer F.	1864	Aug. 19, 1887	Coffin, James H.	1869	Feb. 6, 1873
Barker, George F.	1876 [2]	May 24, 1910	Coffin, J. H. C.	(1)	Jan. 8, 1890
Barnard, F. A. P.	(1, 2)	Apr. 27, 1889	Comstock, Cyrus B.	1884	May 29, 1910
Barnard, J. G.	(1)	May 14, 1882	Cook, George H.	1887	Sept. 22, 1889
Barrell, Joseph	1919 [2]	May 4, 1919	Cooke, Josiah P.	1872	Sept. 3, 1894
Bartlett, W. H. C.	(1)	Feb. 11, 1893	Cope, Edward D.	1872 [2]	Apr. 12, 1897
Becker, George Ferdinand	1901 [2]	Apr. 20, 1919	Coues, Elliott	1877	Dec. 25, 1899
Beecher, Charles Emerson	1899	Feb. 14, 1904	Crafts, James M.	1872	June 21, 1917
Billings, John S.	1883	Mar. 11, 1913	Dalton, J. C.	1864	Feb. 2, 1889
Bôcher, Maxime	1909 [2]	Sept. 12, 1918	Dana, James D.	(1)	Apr. 14, 1895
Boss, Lewis	1889	Oct. 5, 1912	Davidson, George	1874 [2]	Dec. 2, 1911
Bowditch, Henry P.	1887 [2]	Mar. 13, 1911	Davis, Charles H.	(1)	Feb. 18, 1877
Branner, J. C.	1905 [2]	Mar. 1, 1922	Draper, Henry	1877	Nov. 20, 1882
Brewer, William H.	1880 [2]	Nov. 2, 1910	Draper, John W.	1877	Jan. 4, 1882
Brooks, William Keith	1884	Nov. 12, 1908	Dutton, C. E.	1884 [2]	Jan. 4, 1912

[1] Charter members, Mar. 3, 1863.

[2] Biographical memoirs have not been presented.

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Deceased members—Continued.

	Date of election.	Date of death.		Date of election.	Date of death.
Eads, James B	1872	Mar. 8, 1887	Loomis, Elias	1873	Aug. 15, 1889
Emmons, Samuel F	1892	Mar. 28, 1911	Lovering, Joseph	1873	Jan. 18, 1892
Engelmann, George	(1)	Feb. 4, 1884	Lyman, Theodore	1872	Sept. 9, 1897
Farlow, W. G	1879 [2]	June 3, 1919	Mahan, D. H	[4](1)	Sept. 16, 1871
Ferrel, William	1868	Sept. 18, 1891	Mall, Franklin P	1907 [2]	Nov. 17, 1917
Fraser, John Fries	(1)	Oct. 12, 1872	Marsh, G. P	1866	July 23, 1882
Gabb, William M	1876	May 30, 1878	Marsh, O. C	1874 [2]	Mar. 18, 1899
Genth, F. A	1872	Feb. 2, 1893	Mayer, Alfred M	1872	July 13, 1897
Gibbs, Josiah Willard	1879	Apr. 28, 1903	Mayor, A. G	1916 [2]	June 25, 1922
Gibbs, Wolcott	(1)	Dec. 9, 1908	Meek, F. B	1869	Dec. 21, 1876
Gilbert, Grove Karl	1883 [2]	May 1, 1918	Meigs, M. C	1865	Jan. 2, 1892
Gill, Theodore Nicholas	1873	Sept. 25, 1914	Meltzer, Samuel James	1912 [2]	Nov. 8, 1920
Gilliss, James Melville	[3](1)	Feb. 9, 1865	Minot, Charles Sedgwick	1897	Nov. 19, 1914
Goode, G. Brown	1888	Sept. 6, 1896	Mitchell, Henry	1885 [2]	Dec. 1, 1902
Gould, Augustus A	(1)	Sept. 15, 1866	Mitchell, Silas Weir	1865	Jan. 4, 1914
Gould, Benjamin A	(1, [2])	Nov. 26, 1896	Morgan, Lewis H	1875	Dec. 17, 1881
Gray, Asa	(1)	Jan. 30, 1888	Morse, Harmon N	1907 [2]	Sept. 8, 1920
Guyot, Arnold	(1)	Feb. 8, 1884	Morton, Henry	1874	May 9, 1902
Hadley, James	1872	Nov. 14, 1872	Nef, John Ulric	1904 [2]	Aug. 13, 1915
Hague, Arnold	1885	May 15, 1917	Newberry, J. S	(1)	Dec. 7, 1892
Haldeman, S. S	1876	Sept. 20, 1880	Newcomb, Simon	1869 [2]	July 11, 1909
Hall, Asaph	1875	Nov. 22, 1907	Newton, H. A	(1)	Aug. 12, 1896
Hall, James	(1, [2])	Aug. 7, 1898	Newton, John	1876	May 1, 1895
Hayden, F. V	1873	Dec. 22, 1887	Norton, William A	1873	Sept. 21, 1883
Henry, Joseph	(1)	May 13, 1878	Oliver, James E	1872	Mar. 27, 1895
Hilgard, Eugene W	1872	Jan. 8, 1916	Packard, A. S	1872	Feb. 14, 1905
Hilgard, Julius E	(1)	May 9, 1890	Penfield, Samuel L	1900	Aug. 13, 1906
Hill, George William	1874	Apr. 16, 1914	Peters, C. H. F	1876 [2]	July 18, 1890
Hill, Henry B	1883	Apr. 6, 1903	Peirce, Benjamin [5]	(1, [2])	Oct. 6, 1880
Hitchcock, Edward	(1)	Feb. 27, 1864	Peirce, Benjamin Osgood	1906	Jan. 14, 1914
Holbrook, J. E	1868	Sept. 8, 1871	Pickering, Edward C	1873 [2]	Feb. 3, 1919
Holden, Edward Singleton	1885	Mar. 16, 1914	Pierce, Charles S. S	1876 [2]	Apr. 20, 1914
Howe, H. M	1917 [2]	May 14, 1922	Pirsson, Louis V	1913 [2]	Dec. 8, 1919
Hubbard, J. S	(1)	Aug. 16, 1863	Pourtales, L. F	1873	July 19, 1880
Humphreys, A. A	(1)	Dec. 27, 1883	Powell, John W	1880	Sept. 23, 1902
Hunt, T. Stery	1873 [2]	Feb. 12, 1892	Putnam, Frederick W	1885 [2]	Aug. 18, 1915
Hyatt, Alpheus	1875	Jan. 15, 1902	Rodgers, John	(1)	May 5, 1882
Iddings, Joseph P	1907 [2]	Sept. 8, 1920	Rogers, Fairman	(1)	Aug. 22, 1900
James, Williams [3]	1903	Aug. 26, 1910	Rogers, Robert E. [4]	(1)	Sept. 6, 1884
Johnson, S. W	1866	July 21, 1909	Rogers, William A	1885	Mar. 1, 1898
Keeler, J. E	1900	Aug. 12, 1900	Rogers, William B. [5]	(1)	May 30, 1882
King, Clarence	1876	Dec. 24, 1901	Rood, Ogden N	1865	Nov. 12, 1902
Kirtland, Jared P	1865	Dec. 10, 1877	Rosa, E. B	1913 [2]	May 17, 1921
Lane, J. Homer	1872	May 3, 1880	Rowland, Henry A	1881	Apr. 16, 1901
Langley, Samuel P	1876	Feb. 27, 1906	Royce, Josiah	1906 [2]	Sept. 14, 1916
Lea, Matthew Carey	1892	Mar. 15, 1897	Rutherfurd, Lewis M	(1)	May 30, 1892
Le Conte, John	1878	Apr. 29, 1891	Sabine, Wallace C. W	1917 [2]	Jan. 10, 1919
Le Conte, John L	(1)	Nov. 15, 1883	Saxton, Joseph	(1)	Oct. 26, 1873
Le Conte, Joseph	1875	July 6, 1901	Schott, Charles A	1872	July 31, 1901
Leidy, Joseph	(1)	Apr. 30, 1891	Scudder, Samuel H	1877 [2]	May 17, 1911
Lesley, J. Peter	(1)	June 1, 1903	Sellers, William	1873 [2]	Jan. 24, 1905
Lesquereux, Leo	1864	Oct. 20, 1889	Silliman, Benj., sr	(1)	Nov. 24, 1864
Longstreth, Miers F	(1)	Dec. 27, 1891	Silliman, Benj., jr	(1)	Jan. 14, 1885

[1] Charter members, Mar. 3, 1863.
[2] Biographical memoirs have not been presented.
[3] Resigned 1873.
[4] Dropped —, reelected 1875.
[5] Dropped —, reelected 1872.

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Deceased members—Continued.

	Date of election.	Date of death.		Date of election.	Date of death.
Smith, J. Lawrence	1872	Oct. 12, 1883	Watson, Sereno	1880	Mar. 9, 1892
Smith, Richmond Mayo	1890 [2]	Nov. 11, 1901	Wheeler, Henry Lord	1909 [2]	Oct. 30, 1914
Stimpson, William	1868	May 26, 1872	White, Charles A	1880	June 29, 1910
Strong, Theodore	(1)	Feb. 1, 1869	Whitman, C. O	1895	Dec. 6, 1910
Sullivant, W. S	1872	Apr. 30, 1873	Whitney, Josiah D. [3]	(1, [3])	Aug. 19, 1896
Torrey, John	(1)	Mar. 10, 1873	Whitney, William D. [3]	1865 [2]	June 29, 1894
Totten, J. G	(1)	Apr. 22, 1864	Williston, Samuel W	1915 [2]	Aug. 30, 1918
Trowbridge, William P	1872	Aug 12, 1892	Winlock, Joseph	(1)	June 11, 1875
Trumbull, James H	1872	Aug. 5, 1897	Wood, Horatio C	1879 [2]	Jan. 3, 1909
Tuckerman, Edward	1868	Mar. 15, 1886	Woodward, J. J	1873	Aug. 17, 1884
Van Hise, C. R	1902 [2]	Nov. 19, 1918	Worthen, A. H	1872	May 6, 1888
Walker, Francis A	1878	Jan. 5, 1897	Wright, Arthur Williams	1881 [2]	Dec. 19, 1915
Warren, G. K	1876	Aug. 8, 1882	Wyman, Jeffries	(1)	Sept. 4, 1874
Watson, James C	1868	Nov. 23, 1880	Young, Charles A	1872	Jan. 3, 1908

[1] Charter members, Mar. 3, 1863. [2] Biographical memoirs have not been presented. [3] Resigned 1873.

DECEASED FOREIGN ASSOCIATES.

Adams, J. C.
Airy, Sir George B.
Argelander, F. W. A.
Auwers, G. F. J. Arthur.
Backlund, Oskar.
Baer, Karl Ernest von.
Baeyer, Adolf von.
Barrande, Joachin.
Beaumont, L. Élie de.
Becquerel, Henri.
Berthelot, M. P. E.
Bertrand, J. L. F.
Boltzmann, Ludwig.
Bornet, Edouard.
Boussingault, J. B. J. D.
Boveri, Theodor.
Braun, Alexander.
Brewster, Sir David.
Bunsen, Robert W.
Burmeister, C. H. C.
Candolle, Alphonse de.
Cayley, Arthur.
Chasles, Michel.
Chevreul, M. E.
Clausius, Rudolph.
Cornu, Alfred.
Crookes, Sir William.
Darboux, Gaston.
Darwin, Sir George Howard.
Dove, H. W.
Dumas, J. B.
Ehrlich, Paul.
Faraday, Michael.
Fischer, Emil.
Gegenbaur, Karl.
Glydén, Hugo.
Gill, Sir David.
Hamilton, Sir William Rowan.
Helmholtz, Baron H. von.
Hoff, J. H. van't.
Hofmann, A. W.
Hooker, Sir Joseph D.
Huggins, Sir William.
Huxley, T. H.
Ibañez, Carlos.
Janssen, J.
Jordan, M. E. C.
Joule, James P.
Kekulé, August.
Kelvin, Lord.
Kirchoff, G. R.
Koch, Robert.
Kölliker, Albert von.
Kohlrausch, Fredrich.
Kronecker, Hugo.
Lacaze-Duthiers, Henri de.
Leuckart, Rudolph.
Lie, Sophus.
Liebig, Justus von.
Lister, Lord.
Loewy, Maurice.
Ludwig, K. F. W.
Marey, E. J.
Mendeléeff, D. I.
Milne-Edwards, Henri.
Moissan, Henri.
Murchison, Sir Roderick I.
Murray, Sir John.
Oppolzer, Theodore von.
Owen, Sir Richard.
Pasteur, Louis.
Peters, C. A. F.
Pfeffer, Wilhelm.
Plana, G. A. A.
Poincaré, Jules Henri.
Rammelsberg, C. F.
Ramsay, Sir William.
Rayleigh, Lord.
Regnault, Victor.
Retzius, Gustav.
Reymond, Emil Du Bois.
Richthofen, F. von.
Rosenbusch, Karl Harry Ferdinand.
Sachs, Julius von.
Schiaparelli, Giovanni.
Stas, Jean Servais.
Stokes, Sir George G.
Strasburger, Edouard.
Struve, Otto von.
Suess, Eduard.
Sylvester, J. J.
Tisserand, F. F.
Virchow, Rudolph von.
Vogel, H. C.
Waldeyer, Wilhelm.
Weierstrass, Karl.
Weismann, August.
Wöhler, Fredrich.
Wundt, Wilhelm.
Würtz, Adolph.
Zirkel, Ferdinand.
Zittell, K. A. R. von.

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Deceased medalists.

	Medal.	Year awarded.
Abbe, Cleveland	Welfare	1916
Albert I, Prince of Monaco [1]	Agassiz	1918
Auwers, G. F. J. Arthur	Watson	1901
Chandler, Seth Carlo	Watson	1894
Gill, Sir David	Watson	1909
Gorgas, William Crawford [1]	Welfare	1914
Gould, Benjamin Apthorp	Watson	1887
Huggins, Sir William	Draper	1901
Keeler, James Edward	Draper	1899
Langley, Samuel Pierpont	Draper	1886
Newton, Hubert Anson	Smith	1888
Pickering, Edward Charles	Draper	1888
Rowland, Henry Augustus	Draper	1890
Schoenfeld, Ed. [1]	Watson	1889
Vogel, Herman Karl	Draper	1893

[1] Not member, or foreign associate of the academy.

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